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THERAPEUTICS

OF

DRY HOT AIR

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BY

CLARENCE EDWARD SKINNER, M. D., LL. D.

Physician in Charge of the Newhope Private Sanitarium, New Haven, Conn.; Editor of the Archives of Physiological Therapy; Formerly Professor of Thermotherapy at the New York School of Physical Therapeutics; Member of the American Medical Association, American Electro-Therapeutic Association, American Roentgen Ray Society, American Association for the Advancement of Science, Yale Medical Alumni Association, Connecticut Medical Association, New Haven County Medical Society; Associate Fellow New York Academy of Medicine; Foreign Member Société Française d'Electrothérapie et de Radiologie, etc.

SECOND EDITION

ENLARGED AND THOROUGHLY REVISED

NEW YORK

A. L. CHATTERTON & CO.

PUBLISHERS

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1905

DEDICATED

TO THE MEMORY OF THE LATE

DR. HEMAN BANGS SMITH,

WHOSE PERSONALITY, RICH IN THE UNCONSCIOUS NOBILITY OF TRUE MANHOOD, AND OVERFLOWING WITH THE MILK OF HUMAN KINDNESS, WILL ALWAYS BE RECALLED WITH DEEP AFFECTION BY THE AUTHOR.

PREFACE TO SECOND EDITION.

FOR several years past the writer has felt that new forces were coming to the front in the therapeutical world, that were destined in a few years to revolutionize the current methods of treating many disease processes and to greatly increase the inherent efficacy of others; we refer to the so-called "physiological" forces, heat, cold, electricity, the various forms of radiant energy, etc. The first edition of this book was written for the purpose of bringing before the profession one of these forces which the writer's experience had convinced him was destined to become one of the foremost in therapeutical importance and utility, and which was known and understood by but a very small number of medical men. The conviction that a book upon dry hot air would fill an urgent want has been fully confirmed by the manner in which the first edition was received and which has encouraged the author to omit no pains in order that this, the second edition, shall be complete in every respect.

Although the general plan and scope of the work, as embodied in the first edition, remain the same, yet the addition of matter pertaining to many small but important details, and several illustrations which were needed for complete elucidation of the text, has increased somewhat the size of the volume; as the subject-matter has been entirely rewritten and rearranged, however, this increase in size does not interfere with accessibility to the contents, and accessibility is still further facilitated by the exhaustive character of the table of contents and the index.

The plan of mentioning briefly the other remedial measures which it is advantageous to employ in conjunction with dry hot air, has also been retained. As stated in the preface to the first edition, this agent "is not an universal panacea. It is simply a rational therapeutic element which, alone or in combination

with other remedial agents, will increase greatly our power to overcome pathological processes. In order to appreciate its true value, therefore, it must be viewed in its various therapeutical relations, not alone."

At the suggestion of many who have perused the first edition, a number of additional case reports have been introduced to illustrate and demonstrate statements made in the text. The results obtainable with dry hot air are sometimes so magical as to tax uninstructed credulity to the utmost, hence these illustrative cases have been selected, as far as possible, from among those patients who are now alive and accessible; there is no evidence so convincing as that furnished by one's own senses.

His experience, since the first edition was published, has not led the author to change his opinions on any of the cardinal principles therein set forth, but has resulted, as suggested above, in some amplification and development of those principles: the description of these contained herein he believes adds greatly to the value of the present edition as compared with the previous one.

He desires hereby to thank those who have by apt suggestion assisted him in bringing the work to its present degree of usefulness, and to express the hope that this volume will be as helpful to his colleagues in the future as he has been many times informed the previous one has been in the past.

C. E. S.

NEW HAVEN, CONN., *March*, 1905.

PREFACE TO FIRST EDITION.

DRY superheated air as a therapeutical measure has now been before the medical profession for several years, yet as far as the average practitioner is concerned it is still a new and unknown quantity. Even the latest text-books dismiss it with but a mention, and that only in connection with two or three pathological processes. This general ignorance of the agent is to be deplored, as, when skillfully administered, it is one of the most potent and useful at our command and applicable to many disease conditions wherein the ordinary methods of treatment are unsatisfactory.

In the following pages is set forth what has been ascertained in reference to dry hot air therapeusis up to the present time. It has been considered desirable to mention briefly the other remedial measures which it is advantageous to apply to different conditions in combination with dry hot air, because this agent is not an universal panacea. It is simply a rational therapeutic element which, alone or in combination with other remedial agents, will increase greatly our power to overcome pathological processes. In order to appreciate its true value, therefore, it must be viewed in its various therapeutical relations, not alone. Where necessary to elucidate the manner in which dry hot air produces its effects, the pathological features involved in the condition under consideration have been briefly noted.

Many of the failures to secure satisfactory results with dry hot air have been due to the fact that it has been called upon to influence pathological conditions which were not amenable to its physiological action; others more numerous still have been due to faulty technique in its administration. These subjects, therefore, have been treated at some length.

It is not to be expected that every general practitioner will or can become a dry hot air expert, but every physician should at

least understand the principles of its application and the clinical results derivable therefrom, in order that he may be able to decide intelligently when his patient will be benefited by its use. If he does not care to undertake its actual administration he can send his patient to someone who is an expert.

Finally, too much must not be expected of dry hot air, or any other one measure. It will, alone and unaided, cure some disease conditions; others will require all the therapeutical resources at our command; and in still others even all that we have will not suffice to produce a cure. Its powers, however, are exerted in directions in which remedial agents hitherto known have been very deficient; its addition to the treatment results in benefit to many patients who would fail to improve under other measures alone, and its adoption into our armamentarium enables us to increase by a large percentage the sum total of our power over disease. Any agent possessing these attributes is entitled to respect and study. Dry hot air exhibits them in an eminent degree.

CLARENCE EDWARD SKINNER.

NEW HAVEN, CONN., *October*, 1902.

CONTENTS.

CHAPTER I.

APPARATUS.

	PAGE
Outfit,	1
Construction,	1
THE BODY APPARATUS,	2
Structural Modification of Body Apparatus,	2
THE GENERAL LOCAL APPARATUS,	12
THE KNEE APPARATUS,	13
Internal distribution of heat,	13
Elimination of moisture,	14
Fire-proof cloth fittings,	15
Source of heat,	16
Special chair for local application to shoulder,	17
Location of apparatus,	18
DEVICES FOR APPLYING DRY HOT AIR TO THE OPEN CAVITIES OF THE BODY,	18
External auditory canal,	19
The alcohol heater,	19
The gas heater,	20
The electric heater,	21

CHAPTER II.

PHYSIOLOGICAL ACTION.

Differentiation from other methods of administering heat,	23
Electric arc and incandescent light baths,	23
Hydrotherapy,	24
Varieties of application and nomenclature,	25
GENERAL APPLICATION,	25
Body temperature,	25
Pulse,	25
Respiration,	25
Skin,	26
Blood,	26
Urine,	26
Variations in extent of influence induced,	26

PAGE

Subjective phenomena, ... 27
Rationale of action, ... 27
Sphere of action, ... 28
LOCAL APPLICATION, ... 28
Elements of physiological action, ... 28
Temperature elevation of part treated, ... 28
Reflex effects, ... 29
General body temperature and pulse, ... 30
Sphere of action, ... 30
Summary of Physiological Influences, ... 30
General application, ... 30
Local application, ... 31
Clinical applicability. 31
Analogies, ... 32
Fallacies, ... 32
As to identity of the influences exerted by hot and cold applications, ... 32
As to identity of the effects producible with dry hot air and hydrotherapy, ... 37
As to the rationale of its physiological influences, ... 39
As to permanence of results, ... 40

CHAPTER III.

TECHNIQUE.

Methods of preparation, ... 42
LOCAL APPLICATION. 43
Preparation, ... 43
Arms and legs, ... 43
Knee, ... 44
Shoulder, ... 56
Hip, ... 57
Abdomen, ... 57
Chest wall and lumbar region, ... 57
Amount of wrapping necessary, ... 58
Apparatus, ... 58
Administration, ... 58
Duration and Intensity of séance, ... 75
After-care, ... 75
External Auditory Canal, ... 75
Management of the apparatus, ... 75
Preparation of the patient, ... 76

PAGE
Administration, ... 76
GENERAL APPLICATION, ... 76
Preparation, ... 76
Administration, ... 79
Prevention of accidents, ... 81
Intensity and duration of séance, ... 83
After-care, ... 85
In General,
Frequency of administration, ... 86
Intermissions in treatment, ... 86
Burns, ... 87
Contra-indications, ... 87
Atheroma and irregular pulse, ... 88
Valvular heart lesions, ... 88
Pyrexia, ... 88
Hyper-pyrexia, ... 90
Local infective or inflammatory foci, ... 90

CHAPTER IV.

SPRAINS.

Modifications of Clinical Conditions producible with Dry Hot Air, 92
Local Application, ... 92
General Application, ... 92
Rationale of Thermotherapy, ... 92
Pathology and Symptomatology, ... 92
Therapeutic indications, ... 92
Local application, ... 92
General application, ... 93
Illustrative Case, ... 94
Treatment, ... 94
Local dry hot air application, ... 94
General dry hot air application, ... 95
Additional remedial measures, ... 95

CHAPTER V.

RHEUMATISM.

Modifications of Clinical Conditions producible with Dry Hot Air, 97
Local Application, ... 97
General Application, ... 97
Rationale of Thermotherapy, ... 97
Etiology, pathology, and symptomatology, ... 97

PAGE

Therapeutic indications, ... 99
Local application, ... 99
Is salicylic acid a specific for rheumatism? 101
General application, ... 105
Diagnosis, ... 105
Illustrative Cases, ... 106
Acute rheumatism, ... 106
Chronic rheumatism, ... 109
Treatment, ... 110
Clinical forms of rheumatism, ... 110
Complications, ... 111
Local dry hot air application, ... 111
After-care, ... 112
General dry hot air application, ... 112
Additional remedial measures, ... 113
Diet, ... 113
Drugs, ... 113
Aspirin, ... 113
Salicin, ... 114
Sodium salicylate, ... 114
Salophen, ... 114
Methyl salicylate, ... 114
Alkalies, ... 114
Salines, ... 115
Electricity, ... 115
The static current, ... 115
The magnetic-induced current, ... 115
The Voltaic current, ... 115
Chronic rheumatism, ... 116
Treatment, ... 116

CHAPTER VI.

LOCAL SEPTIC INFECTION.

Modifications of Clinical Conditions producible with Dry Hot Air, 117
Local Application, ... 117
General Application, ... 117
Rationale of Thermotherapy, ... 118
Etiology and pathology, ... 118
Therapeutic indications, ... 119
Local application, ... 119
General application, ... 121
Illustrative Cases, ... 122

PAGE
Treatment, ... 126
Local dry hot air application, ... 126
General dry hot air application, ... 127
Additional remedial measures, ... 128
Diet, ... 128
Drugs, ... 128
Operative interference, ... 128
Electricity, ... 128

CHAPTER VII.

PNEUMONIA.

Modifications of Clinical Conditions producible with Dry Hot Air, 130
Local Application, ... 130
General Application, ... 130
Rationale of Thermotherapy, ... 131
Etiology and pathology, ... 131
Therapeutic indications, ... 134
Local application, ... 135
General application, ... 138
Illustrative Cases, ... 138
Treatment, ... 144
Local dry hot air application, ... 144
After-care, ... 144
General application, ... 147
Heart failure, ... 148
Additional remedial measures, ... 148
Drugs, ... 148

CHAPTER VIII.

ALBUMINURIC NEPHRITIS (BRIGHT'S DISEASE).

Modifications of Clinical Conditions producible with Dry Hot Air, 150
Local Application, ... 150
General Application, ... 150
Rationale of Thermotherapy, ... 150
Etiology, ... 150
Symptomatology and pathology, ... 151
Nature of specific toxin, ... 153
Therapeutic indications, ... 156
General application, ... 157
Illustrative Cases, ... 157
Treatment, ... 166

PAGE
General dry hot air application, ... 166
Additional remedial measures, ... 167
Diet, ... 167
Clothing, ... 167
Drugs, ... 167
Electricity, ... 167

CHAPTER IX.

ARTHRITIS DEFORMANS.

Modifications of Clinical Conditions producible with Dry Hot Air, 169
Local Application, ... 169
General Application, ... 169
Rationale of Thermotherapy, ... 169
Etiology and pathology, ... 170
Neural theory, ... 170
Rheumatism as a causative factor, ... 172
Symptomatology, ... 173
Pain, ... 173
Body temperature, ... 174
Nervous system, ... 174
Muscular atrophy, ... 175
Muscular spasm, ... 175
Skin, ... 175
Albuminuria, ... 176
Joint appearances, ... 176
Diagnosis, ... 177
Symptomatology, ... 177
The Roentgen ray, ... 178
Inconstancy of symptom complex, ... 181
Therapeutic indications, ... 182
Local application, ... 182
General application, ... 182
Illustrative Cases, ... 183
Treatment, ... 188
Local dry hot air application, ... 188
General dry hot air application, ... 189
Additional remedial measures, ... 190
Electricity, ... 190
The static current, ... 190
D'Arsonvalization, ... 191
The continuous current, ... 191
Magnetic-induced current, ... 192
Mechanical vibratory stimulation, ... 192

PAGE
Massage, ... 193
Diet, ... 193
Clothing, ... 193
Drugs, ... 194
Alteratives and tonics, ... 194
The salicylates, ... 194
Laxatives, ... 195
Digestants, ... 195
Pain-relieving agents, ... 195
Management of affected joints, ... 196
Routine treatment, ... 196
Relapses, ... 198

CHAPTER X.

PERITONITIS; PLEURITIS; SYNOVITIS; NEURITIS AND SCIATICA; LITHÆMIA AND GOUT; NEURALGIA AND MYALGIA; VARICOSE ULCERS; OTITIS.

Peritonitis, ... 200
Varieties, ... 200
Sphere of usefulness of dry hot air, ... 200
Illustrative Case, ... 202
Treatment, ... 206
Local dry hot air application, ... 206
General dry hot air application, ... 206
Additional remedial measures, ... 206
Pleuritis, ... 211
Varieties, ... 211
Sphere of usefulness of dry hot air, ... 211
Treatment, ... 212
Local dry hot air application, ... 212
General dry hot air application, ... 212
Additional remedial measures, ... 213
Synovitis, ... 213
Varieties, ... 213
Sphere of usefulness of dry hot air, ... 213
Treatment, ... 215
Local dry hot air application, ... 215
After-care, ... 215
General dry hot air application, ... 216
Additional remedial measures, ... 216
Neuritis, ... 217

PAGE

Etiology, ... 217
Treatment, ... 217
Dry hot air, ... 217
Additional remedial measures, ... 218
Electricity, ... 218
Diet, ... 218
Drugs, ... 218
Physiological rest, ... 219
Sciatica, ... 219
Causation and pathology, ... 219
Sphere of usefulness of dry hot air, ... 219
Illustrative Case, ... 220
Treatment, ... 221
Sciatic rheumatism, ... 221
Sciatic neuritis, ... 222
Electricity, ... 222
Mechanical vibratory stimulation, ... 223
Immobilization, ... 224
Operative interference, ... 224
Lithæmia, ... 224
Definition of term, ... 224
Etiology, pathology, and clinical characteristics, . . . 224
Therapeutic indications, ... 226
Treatment, ... 226
Diet, ... 226
General dry hot air application, ... 226
Electricity and hydrotherapy, ... 227
Drugs, ... 227
Exercise, ... 227
Gout, ... 227
Neuralgia, ... 228
Treatment, ... 229
General dry hot air application, ... 229
Local dry hot air application, ... 229
Electricity, ... 230
Drugs, ... 230
Myalgia, ... 230
Varicose Ulcers, ... 231
Treatment, ... 231
Local dry hot air applications, ... 231
General dry hot air applications, ... 231
Electricity, ... 231

PAGE
Drugs and surgical dressings, ... 232
Otitis, ... 232

CHAPTER XI.

MISCELLANEOUS CONDITIONS.

Nervous Debility and Exhaustion, ... 236
General debility and the convalescent state, ... 236
Pulmonary tuberculosis, ... 238
Chronic bronchitis, ... 241
Fibrous anchylosis, ... 241
Cholelithiasis, ... 242
Gangrene, ... 244
Angina pectoris, ... 245
La grippe, ... 246
Syphilis, ... 247
Alcoholism, ... 247
Gynecic affections, ... 248
Malaria, ... 249
Myositis, ... 249
Osteomyelitis, ... 250
Periosteitis, ... 250
Muscular adhesions, ... 250
Skin Diseases, ... 251
Plumbism, ... 251
Typhoid fever, ... 251
Pains of flat-foot, ... 253
Obesity, ... 254

CHAPTER XII.

FIELDS OF FUTURE RESEARCH.

Erysipelas, ... 255
Tetanus, ... 255
Lupus, ... 256
Surgical Shock, ... 256
Hodgkin's Disease, ... 256
Multiple Neuritis, ... 257
Tabes Dorsalis, ... 257
Diabetes Mellitus, ... 257
Mental Aberrations, ... 257
The Infectious Diseases, ... 257
Cerebro-Spinal Meningitis, ... 258

LIST OF ILLUSTRATIONS.

		PAGE
I.	The Sprague Body Dry Hot Air Apparatus . . .	3
II.	Patient Undergoing Treatment in the Sprague Body Apparatus	3
III.	Patient Undergoing Treatment in Betz Body Apparatus	5
IV.	Pedal End of a Modified Body Apparatus . . .	7
V.	Cephalic End and Side of a Modified Body Apparatus .	9
VI.	Lentz & Sons' Apparatus for the Local Application of Dry Hot Air	12
VII.	The Sprague Apparatus for the Local Application of Dry Hot Air	13
VIII.	Chair Devised by the Author for Use in Administering Local Dry Hot Air Treatments to the Shoulder Joint	17
IX.	The Hopkins Generators for Applying Dry Hot Air *via* the External Auditory Canal . . . 19, 20,	21
X.	Applying Turkish-Toweling Strips Preparatory to Local Application of Dry Hot Air to Knee with Special Knee Apparatus	45
XI.	Patient Prepared for Local Application of Dry Hot Air to Knee with Special Knee Apparatus . . .	47
XII.	Patient Prepared for Local Application of Dry Hot Air to Leg from Knee Downward	49
XIII.	Local Application of Dry Hot Air to Leg from Knee Downward with Betz General Local Apparatus .	51
XIV.	Local Application of Dry Hot Air to Knee with Betz Special Knee Apparatus	53
XV.	Position of Covering Preparatory to Adjustment for Local Dry Hot Air Application to Shoulder . .	59
XVI.	Shoulder Prepared for Local Dry Hot Air Application	61
XVII.	Local Dry Hot Air Application to Shoulder . . .	63
XVIII.	Hip Prepared for Local Dry Hot Air Application .	65
XIX.	Local Dry Hot Air Application to Hip	67
XX.	Local Dry Hot Air Application to Lumbar and Sacral Regions	69
XXI.	Patient Prepared for Local Dry Hot Air Application to Left Lung or Pleuræ	71

		PAGE
XXII.	Patient Prepared for Body Dry Hot Air Treatment with the Bare Body Apparatus	77
XXIII.	Local Application of Dry Hot Air to Left Lung or Pleura	145
XXIV.	Changes in Joint Structures Produced by Arthritis Deformans of the Fingers	179
XXV.	Normal Finger Joints a Fragment of a Needle Appears Imbedded in the Middle Finger opposite the Third Phalanx	179
XXVI.	Arthritis Deformans of the Knee	181
XXVII.	Patient Prepared for Local Application of Dry Hot Air to Abdomen	207
XXVIII.	Local Application of Dry Hot Air to Abdomen . . .	209

THERAPEUTICS OF DRY HOT AIR.

CHAPTER I.

APPARATUS.

Outfit.

Three forms of apparatus are essential in order that the most may be gotten out of dry hot air therapeusis as applied to the practice of general medicine: a large one for treating the whole body at once; a smaller one for treating hands, wrists, elbows, shoulders, backs, abdomens, hips, ankles, and feet; and a short one, open at both ends, for treating ankylosed, flexed knees.

Construction.

All of these consist in general of metal cylinders lined with some non-conducting material, and are susceptible of being closed at both ends in such a way as to confine the air they contain about the part to be treated. The proximal end is closed by cloth attachments so constructed as to fit the different regions of the body to which it may be desired to apply the heat; the distal end by curtains of cloth or a permanent metal stopper.

Gas, gasoline, electricity, and alcohol are used for generating the heat, and high temperature thermometers are placed conveniently for registering the intensity obtained.

There are several makes of apparatus on the market, the working principle of all being the same, but they differ in construction and price. That manufactured by F. S. Betz & Co., of Chicago, Ill., and the Sprague apparatus made by the Kny-Scheerer Co., of New York, N. Y., are most commonly used in this country. As it is the cardinal principles of construction rather than the details that combine to render an apparatus

of this character therapeutically efficient, and as the details can be secured from the different manufacturers without difficulty, only the essential attributes that must be common to all dry hot air machines in order that they shall be therapeutically reliable will be mentioned here; these are as follow:

THE BODY APPARATUS.

This should be capable of generating a heat of at least 300° F. in fifteen minutes and 350° F. in thirty minutes at the outside, and of sustaining it there for at least an hour.

The source of heat should be so arranged that the flame cannot be directed toward the patient without having some non-conducting material interposed, however great the distance between them.

It should be provided with some arrangement, by valves or otherwise, whereby the air may be changed frequently without lessening the heat to any great extent. If free circulation of air in the apparatus is not attainable it will become so saturated with moisture that the skin of the patient will be in danger of blistering.

Because of its size and weight this form of apparatus is not portable, hence is available only when the patient can be brought to it and in sanitariums or hospitals.

When illuminating gas is used for heating this form of apparatus a pipe at least three-quarters of an inch in diameter, and connected directly with the large street service pipe, should be directly available for supplying the burners under the ordinary pressure conditions. With a smaller supply than this it will not usually be possible to secure the high temperatures without which satisfactory results cannot be attained in many conditions.

Structural Modification of Body Apparatus.—There are two forms of body apparatus; one in which both ends of the cylinder are closed by cloth curtains, and the other in which only the cephalic end is so constructed, the pedal end being permanently occluded by a metal stopper. As will be seen in a later chapter, the sensitiveness of the toes of some patients renders it necessary to conduct the application by this appa-

I.—The Sprague Body Dry Hot Air Apparatus.

II.—Patient Undergoing Treatment in Sprague Body Dry Hot Air Apparatus.

III.—Patient Undergoing Treatment in the Betz Body Apparatus.

IV.—Pedal End of a Modified Body Apparatus.

V.—Cephalic End and Side of a Modified Body Apparatus.

ratus with these members entirely outside of the heat reservoir; hence with the last-mentioned form of body apparatus it is desirable to effect some changes in its construction whereby this object may be attained, and the aid of a tinsmith must be invoked.

The whole upper segment of the pedal end of the cylinder down to a point an inch or two below the under side of the rolling couch should be cut out, so that the end of the car upon which are the patient's feet can be rolled far enough through the pedal end of the cylinder to allow those members to project beyond the limits of the heat chamber. Curtains of heavy awning cloth should then be fitted to the upper and under borders of the opening thus made, in the same manner as they are arranged at the cephalic end of the cylinder, and of such shape and size as will allow the upper curtain to be tucked around the patient's ankles and the under curtain to be drawn snugly against the under side of the rolling couch. This arrangement answers the purpose admirably and is entirely effectual in preventing undue escape of the heated air.

As the hot air reservoir in the machine with permanently-closed end is five feet long, it follows that with patients of medium height the head would be inside the reservoir when the feet were protruded as above, so that it becomes necessary also to cut off about sixteen inches of the cylinder; this is most advantageously accomplished by taking some from each end. Cut IV shows the pedal end of such an apparatus which has been altered in accordance with the above suggestions, and Cut V shows the side and cephalic end. Six inches were cut off from the pedal end and ten inches from the upper half of the cephalic end, as shown in the cut.

Another modification shown in Cut V is the hole in the side near the top; it is seven inches square, fitted with a sliding door, and is used for ventilating the apparatus. The rapidity with which the air is changed may be regulated at will by sliding the door backward or forward so as to increase or diminish the size of the aperture.

THE GENERAL LOCAL APPARATUS.

This is the one most useful to the general practitioner. A very important requirement is that it be portable as it is frequently desirable to employ it at the bedside in some acute diseases.

It should be capable of generating a heat of at least 400° F.

VI.—Lentz & Sons' Apparatus for the Local Application of Dry Hot Air.

in at most thirty minutes and of sustaining it there for at least an hour.

The same conditions as to arrangement of the source of heat with relation to the patient apply here as with the body apparatus, but with more force, because the temperatures used are higher.

An arrangement for securing free circulation of the air is also essential in this apparatus. A very serviceable modification consists in having the ventilation valve in the top enlarged to a hole five inches square and fitted with a sliding door; an

arrangement similar to that shown in Cut V on the body apparatus.

VII.—The Sprague Apparatus for the Local Application of Dry Hot Air.

THE KNEE APPARATUS

Theoretically the same requirements noted in connection with the two preceding forms of apparatus should apply with equal force to this one; there are practical difficulties in the way of securing the higher degrees of heat, however, which will be noted and discussed in the chapter on technique.

Internal Distribution of Heat.

An essential of prime importance as regards efficiency in all these forms of apparatus is that the heat should equalize itself

within narrow limits in all localities inside of the reservoir after the apparatus is thoroughly heated. Schreiber conducted a series of thermometric observations with some dry hot air machines of foreign make and ascertained that a difference sometimes obtained between the temperature of the air which actually came in contact with the patient, and that in the locality ordinarily occupied by the thermometer, of fifty per cent. of the thermometer reading. A construction producing such conditions renders the apparatus entirely unfit for therapeutical purposes. The discrepancy should not exceed five per cent. of the thermometer reading with a body apparatus, or fifteen per cent. with one designed for local application, and thermometric determinations made by the writer demonstrate that these limits need never be exceeded. In apparatus of American manufacture they are not usually reached. The simpler the design of the machine the more effectually will the convection currents effect a thermal equilibrium.

Elimination of Moisture.

It has been suggested that dryness of the air in the cylinders might be maintained by the use of some absorbent substance inside the apparatus, or by passing a static electrical discharge through a tube located in the interior of the reservoir whereby the moisture would be precipitated upon the tube; by such means temporary slight irregularities of temperature caused by changing the air in the apparatus might be avoided. To dispose of the point it is only necessary to consider that at the high temperatures necessary for therapeutical purposes no chemical is known that would retain the moisture even if it were possible for it to absorb it under such conditions, and however successful we might be in precipitating the moisture by electrical or any other means, it would inevitably vaporize again immediately upon coming in contact with a solid body so heated. Changing the air, therefore, is the only practical means now available for maintaining dryness, and the efficiency and convenience of the procedure are such that no other need be sought for; its actual influence in disturbing the treatment temperature after the apparatus has once become thoroughly heated, is found in practice to be entirely negligible.

Fire-Proof Cloth Fittings.

Although reasonably close observance of the cautions which will be detailed in the chapter on technique will eliminate any danger of serious ignition of the cloth attachments of the machines, yet scorching will occur which greatly shortens their periods of usefulness. This disadvantage may be obviated or lessened by substituting asbestos cloth for the fabric ordinarily used in their construction, or by treating the attachments before they are used with some fire-proofing solution, the following being a fairly efficient example; it is known as the "Home Office Method," and is used by the explosives department of the British Home Office for fire-proofing inflammable substances:

Sodium tungstate (normal salt) 4 ounces or q. s. to make Sol. Sat.

Water, 30 ounces.

Dissolve in the cold and add

Sodium phosphate, 2 ounces,

Water, 6 ounces,

or a sufficiency of water to make the specific gravity of the solution 1140.

The fabrics are soaked in this solution about half an hour until thoroughly saturated therewith, placed in the apparatus without being squeezed so as to retain in the meshes of the cloth all of the solution that can be held therein, and heated at 350° F. to remove the organic acid and cause the tungstate precipitate to be formed in the fiber, until dry.

The use of asbestos cloth is the most satisfactory, as it eliminates absolutely any possibility of ignition; the fire-proofing solution lengthens considerably the life of the fittings, however, and is less expensive.

When asbestos cloth is used for the curtains of the body apparatus or the various attachments of the local machine, the wear upon it will be greatly lessened by having a layer of ordinary awning cloth outside of the asbestos, thus making a curtain of double thickness, the inner layer being of asbestos and the outer of awning cloth.

In some body machines inflammable material, as wood, is

leans back and the heated air will thus be prevented from reaching the posterior portion of the joint; if the patient leans far enough laterally to overcome this condition his position will shortly become irksome. The sharp backward curving of the side-pieces and the shaping of the canvas back at the level of the shoulders shown in Cut VIII obviate this difficulty entirely and render it possible to carry the heat as far toward the median line as the inner border of the scapula.

Location of Apparatus.

Little need be said as to the setting of the local dry hot air generators except that the comfort of both patient and operator will be enhanced if the room wherein the treatment is to be given is provided with a window which can be opened during the application. The great majority of these treatments can be given at an ordinary bedside as conveniently as in a room especially prepared for the purpose.

The greater size, hence greater heating and de-oxygenating capacity as regards the air of the room, of the body apparatus, however, renders free ventilation by open windows or otherwise an essential feature of the apartment wherein these applications are to be administered, and in the summer time at least an electric fan, so arranged that the breeze can be directed upon the patient, will be found to constitute a most desirable feature of its equipment.

It is also desirable to have the bathing facilities as near the treatment room as possible so that the patient will not have far to go after cooling. A couch upon which the patient can be given an alcohol rub and left to rest for an hour or two after the treatment, should be located in a room conveniently accessible from the bathroom.

Other minor details will suggest themselves as the individual operator develops his facilities.

DEVICES FOR APPLYING DRY HOT AIR TO THE OPEN CAVITIES OF THE BODY.

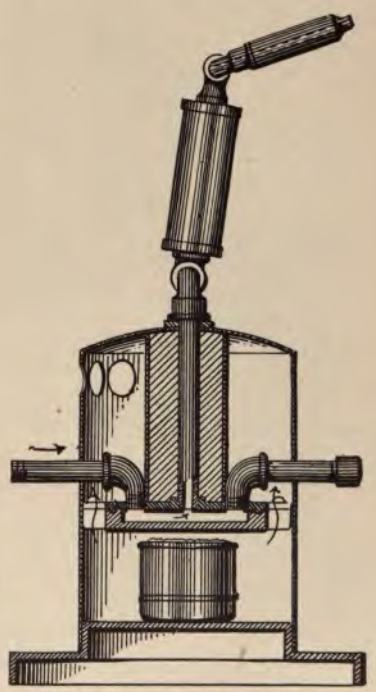
Modifications of the previously described forms of apparatus, more or less well adapted for applying this agent to open cavities, are procurable, but as they have been employed to only a limited extent as yet, their actual therapeutical value cannot be passed upon with any degree of conclusiveness.

External Auditory Canal.

One of them, however, the Hopkins heater, designed by Hopkins, of Cleveland, O., for use in the external ear and made by the Terry Heater Co., of Cincinnati, O., deserves more than a mention, because of the very satisfactory results that have been reported from its use. It is made in three forms so that alcohol, illuminating gas, or electricity may be utilized as the source of heat. The air is compressed before being heated, so that it is delivered to the field of operation with some force.

The Alcohol Heater (Cut IX).—This form consists of a metal cone segment, around the inside of which is wound a

IX *A*.—Alcohol Heater.



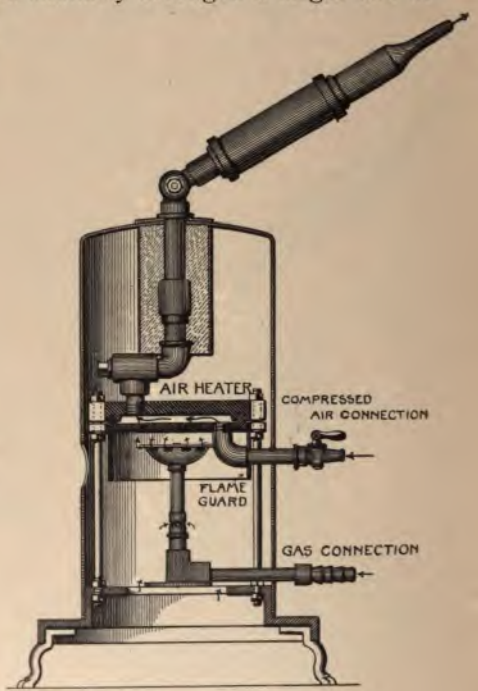
IX *A*.—Cross-Section.

tapering coil of copper tubing. Beneath it is an alcohol lamp which heats the coil to a high temperature in a few minutes.

Compressed air from a tank, pump, or bulb enters the heating coil at the bottom through rubber tubing, and leaves it at the top through a metallic delivery tube having two rotary joints which make it adaptable to any position of the patient, the delivery tube terminating in a vulcanized fiber ear-tip shaped somewhat like an ear speculum. This ear-tip is said not to become inconveniently hot even when the hottest air is passing through it. The capacity of this heater as regards temperature elevation of the air delivered is said to be much less than that exhibited by those utilizing gas or electricity.

The Gas Heater (Cut IX).—This form consists of a blue-flame burner, over which is similarly arranged a larger coil of

IX *B*.—Gas Heater.

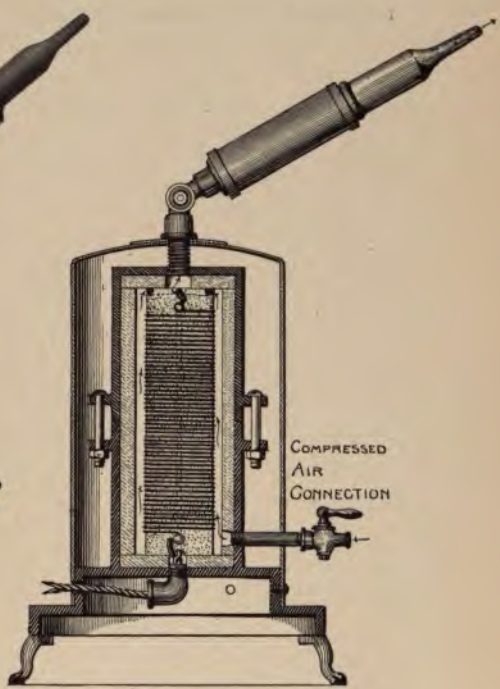


IX *B*.—Cross-Section.

copper tubing, and the compressed air enters and leaves the coil in the same manner.

The Electric Heater (Cut IX).—This machine is operated by the 110-volt lighting circuit through an ordinary socket and plug and can be used on either the direct or alternating current.

IX *C.*—Electric Heater.



IX *C.*—Cross-Section.

It consists of an air-tight tube holding within it a coil of wire which is heated by the current. This tube is surrounded by a nickel-plated envelope, the intervening space being packed with asbestos. The wires enter the tube at the bottom through a bushing. The compressed air enters the tube at the bottom and leaves it at the top as with the alcohol and gas heaters. Air passing through this appliance acquires its maximum temperature elevation (over 400° F.) in eight minutes.

A marked advantage exhibited by the Hopkins machines is that the compressed, heated air is compelled to escape, with

a degree of force which is absolutely controllable, at exactly the spot desired and nowhere else.

Directions for setting up and operating all of these outfits, together with complete fittings and descriptions thereof, are furnished by the manufacturers.

CHAPTER II.

PHYSIOLOGICAL ACTION.

COMPREHENSION of the applicability of this agent to different disease processes, of the rationale of its action, and of the value of the services it renders will be facilitated if the following is borne prominently in mind while considering this subject, viz., that in at least a large majority of pathological conditions Nature's attempt to rid herself of disability is simply and solely through an accentuation or exaggeration, direct or indirect, of the normal metabolic processes. As illustrations may be mentioned the increase in local trophic activity accompanying repair in wounds; the increase in cell production whereby it is attempted to wall off a chronic inflammatory focus from the rest of the organism; the acceleration of metabolism whereof the phenomenon of fever is the outward and visible sign, is also believed by many to be simply an expression of Nature's effort to rid herself of deleterious agencies by augmentation of the normal vital processes, through which alone is she able to resist or destroy such agencies.

The greater the facility and vigor with which normal tissue changes are carried on the greater will be the individual's vitality, hence capacity for resisting influences antagonistic to his well-being and of overcoming the results of such influences if he should become a victim thereto.

Differentiation from Other Methods of Administering Heat.

Electric Arc and Incandescent Light Baths.—A most important point to be borne in mind in this connection is that dry hot air is *not radiant heat* or *moist* heat. The physiological influences of the electric arc and incandescent light baths are radically different in several respects from those of the dry hot air application proper, the former being a combination, in

varying proportions and degrees of intensity, of both heat and light effects, the radiant element being always predominant, however. With the dry hot air application, properly so called, we do not get any of the characteristic effects of light waves upon cell life, and clinically, the work of Cleaves, Crothers, and others would seem to indicate that the radiant heat bath differs radically in at least one particular from its non-luminous congener, viz., in its greater power of producing sedation of the irritable nervous system.

The purely thermal element in the radiant heat application is necessarily much less intense than in the dry hot air application proper because of the predominance of the chemical rays in the former. We should expect, then, that radiant heat would not be able to perform the work of dry hot air, and that the latter would fail in some respects to accomplish the results attainable with its radiant relative, and experience proves this to be true. The explanation of the difference in the physiological influences characteristic of dry hot air as compared with radiant heat, is found principally in the greater power exhibited by dry hot air to induce elimination and to influence by reflex stimulation the deep nerve centers.

Hydrotherapy.—Its physiological effects must also be differentiated from those of the various hydrotherapeutic procedures in which a greater or less degree of heat is employed. In the latter the degrees of heat administered are necessarily much less than with dry hot air applications proper because they are applied by means of water, and the physiological effects of *mild* degrees of heat are in some respects *directly the reverse* of those obtainable by the use of high intensities. In addition to this we have to reckon, in some of the hydriatic modalities, with the element of *percussion,* which still further modifies any possible resemblance that might otherwise obtain.

The differences in the elements which combine to produce the characteristic influences obtainable by the use of these three methods of applying heat, then, are sufficiently marked to constitute radical differences in the spheres of action of dry heat, radiant heat, and hydrotherapy, and in the securing of a satisfactory therapeutical result the selection becomes a matter of

importance; they are by no means mutually interchangeable.

Varieties of Application and Nomenclature.—There are two varieties of dry hot air applications; one where the greater part of the body surface, sometimes the whole of it up to the neck, is subjected to influence and which is denominated the "General Application" or "Body Treatment," and the other where only the part involved in a pathological process is included in the field of operation and which is denominated the "Local Application" or "Local Treatment." The physiological actions of these two varieties of administration differ from each other in degree and to a certain extent also in kind; we will, therefore, consider them separately, beginning with the major procedure.

GENERAL APPLICATION.

Clinical and laboratory observations made in connection with patients under treatment by the writer have demonstrated that the following objective phenomena are susceptible of immediate induction by the body treatment, and that they persist with decreasing intensity for from four to forty-eight hours, rarely longer, the time varying in different diseases and with different patients.

Body Temperature.—The mouth temperature rises from one to five degrees Fahrenheit, according to the length and intensity of the application and the susceptibility to stimulation of the individual patient's nerve centers.

Pulse.—The rate is accelerated from thirty to fifty beats per minute, and the impulse is markedly increased in volume. If it was weak before treatment it becomes strong during administration. If the application is continued too long it loses its volume and strength, becoming rapid, small, and soft; under these conditions the patient becomes faint, dizzy, and nauseated.

Respiration.—The breathing deepens some and the rate increases from five to ten cycles per minute; this modification of function is not accompanied by any sensation of oppression on the part of the patient, however; rather the reverse, in fact.

Skin.—The capillary areas become injected, but this phenomenon is not as marked in the regions actually in contact with the heat as in the local treatment. The fact that the capillaries of the face, which is never subjected to the heat, share this general distention even when constantly under the influence of the breeze from an electric fan, demonstrates the profundity of the influence obtained and that it is essentially *reflex* in character.

The sweat-glands functionate copiously, sometimes excreting several pounds (from one to five) during treatment; if dropsy is present the excretion may be much greater even.

Blood.—The number of white corpuscles is increased in different cases from fifteen to fifty per cent.

The red blood cells are increased from ten to twenty per cent.

Urine.—The quantity passed in the twenty-four hours succeeding the treatment is usually increased from twenty-five to one hundred per cent. over that passed during the twenty-four hours preceding. In occasional instances, however, a decrease in the quantity is observed.

The quantity of urea excreted in the twenty-four hours succeeding the treatment is increased from fifteen to sixty per cent. over that excreted during the twenty-four hours previous.

Variations in Extent of Influence Induced.—The degrees in which these several phenomena are found to be present differ widely in different cases, and at present it is not possible to define positively the reasons for the variation or the conditions under which it may be expected to appear. A general rule which seems to apply fairly constantly, however, is that the greater the departure from normal function in a direction the reverse of that in which tends the influence of the dry hot air treatment, the more pronounced will be the effect of the treatment in the direction indicated above. For instance, in pathological conditions characterized by a deficient excretion of urine or urea, the increase in the excretion of these compounds may be expected to be pronounced; in cases exhibiting a marked hyperleucocytosis on the other hand, only a slight increase in the number of leucocytes, sometimes none at all, and again

an actual decrease may be observed, especially if the pathological process which is responsible for the excessive formation of white corpuscles is gotten under immediate control. In healthy individuals who exhibit no departure from the normal, only slight modification may be expected in most cases; nearly always some is observable, however, in the directions noted above.

Subjective Phenomena.—The sensation is rarely disagreeable to the patient, but quite the reverse usually. A pleasant languor is produced after about ten minutes which lasts for an hour or two; after the treatment the patient usually becomes drowsy and sleeps. If the application is continued too long the languor gives place to exhaustion, sometimes accompanied by cardiac palpitation and oppressed breathing which may persist for hours. A sense of exhilaration and increased vitality follows the treatment when well administered.

Rationale of Action.—Through the elevation of the temperature of the body *en masse* and the profound reflex stimulation of the deep nerve centers, are secured, first, a more rapid and complete oxidation of effete materials which are clogging metabolic processes, figuratively speaking, into normal excretory products—urea for the kidneys, CO^2 for the lungs, etc.—which are then easily disposed of by the appropriate organs; and, second, an accelerated production of healthier and more vigorous cell elements, which are much better able than their predecessors to resist toxæmia and microbic invasion and to carry on the function of tissue reconstruction. We not only obtain a corrective influence in nutritional and constitutional disorders, the origin of which is in the trophic nervous system, but if the patient is suffering from an infectious invasion we increase vastly the resisting power of his phagocytes and tissue elements. The profuse perspiration carries out with it a certain amount of any toxin that may be present and thus assists in relieving depression of vital nerve centers.

The functional activity of every organ and tissue in the body is immediately augmented, but this exaltation of function is not followed by a reactionary debility if good judgment and

proper technique have controlled the administration. Patients usually continue to improve in health and strength for months after a course of body dry hot air treatments.

The physiological action of this measure, then, is predominantly reflex through the sympathetic and spinal nerve centers, the area of skin treated being so great that the capillary circulation is able to dissipate the heat before it penetrates deeply enough to exert its action *directly* upon the underlying structures to any great extent, herein differing, as we shall see, from the local application.

Sphere of Action.—When we consider the large number of pathological conditions which are dependent wholly or in part upon the occurrence in the system of sub-oxidation, and the retention in the circulation and tissues of its products or of various toxins of other origin, the influence of the body dry hot air application upon oxidation and the excretory function assumes an interesting significance; and when, in addition, we think of the number and variety of diseases in which the resistive and reconstructive functions are deficient, the reflex nervous phenomena and modifications in the composition of the blood noted above are scarcely less attractive. The field of usefulness of this measure, therefore, extends within limits of considerable magnitude.

LOCAL APPLICATION.

Elements of Physiological Action.—This therapeutical measure affects physiological function in two ways: first, by a direct stimulation of cell metabolism in the part treated, due to the raising of its temperature *en masse;* and, second, by reflex acceleration of cell nutrition set up by the stimulating influence of the heat upon the numerous nerve endings in the skin.

Temperature Elevation of Part Treated.—It is, of course, not possible to raise the temperature, *en masse*, of one portion of the body very much higher than that of the rest of the organism, but by placing the bulb of a clinical thermometer at the bottom of a deep sinus and then applying a local dry hot air treatment it has been demonstrated that an increase

of about twelve degrees Fahrenheit can be induced. This is enough to accelerate oxidation processes very perceptibly.

In diseases characterized by the presence of pathogenic micro-organisms in the part treated, as local septic infection or pneumonia, the inhibitive influence of this element of the physiological action upon the growth and activity of the germs is very evident. It has been suggested that the germs in these cases were directly destroyed by the heat, but this view is improbable; there is no experimental or clinical evidence available which can be looked upon as indicating that it is possible to raise the temperature of any portion of the body sufficiently high to render such a result attainable. It is more likely that the effects are produced indirectly through augmentation of cell vitality and acceleration of local metabolism.

Reflex Effects.—Through the reflex influence is obtained an emphatic local hyperæmia which, together with the stimulation of the trophic nerve supply of the part treated, results in greatly increased local nutrition.

Copious perspiration appears upon the region treated and in greater or less degree upon the rest of the body. This secretion is strongly impregnated with fatty acids, whatever the disease from which the patient is suffering, or even if he has no disease at all. If a toxin is being elaborated in the part treated a large proportion of it is thus eliminated before it enters the general blood current, and that which has already entered the circulation is eliminated in direct proportion as the perspiration induced upon the body surface is profuse.

To these profound influences upon the circulatory, excretory, and metabolic functions of the part whereby stasis is relieved, is probably due the powerful effect of dry hot air treatments in relieving pain and swelling.

That these applications are sometimes capable of exerting profound reflex influence upon parts physiologically related to but actually distant from the field of direct administration, was demonstrated in a case reported by Walsh. The patient had eczema of both hands; one only was subjected to the treatment, yet both got well. Cases also have been reported where pains in a limb on one side of the body have been

relieved while the corresponding limb on the opposite side was being treated.

It will be observed that all of these effects tend greatly to increase the assimilation and absorption of remedies, in the tissues wherein such effects are induced.

General Body Temperature and Pulse.—These are rarely much modified by the local application. Patients will sometimes exhibit an increase of a fraction of a degree in the former or an acceleration amounting to eight or ten beats per minute in the latter; modification to these extents is, of course, not capable of influencing the general metabolic functions markedly.

Sphere of Action.—The influence of the local application, then, is practically confined to the part treated. What effects are produced upon the organism as a whole are principally secondary to changes induced in the local disease focus; hence it will not and should not be expected to cure, unaided, pathology of general or central primary causation. For instance, local treatments alone will not cure the joint lesions of arthritis deformans because these lesions are but secondary manifestations of impaired general trophic functions; they will in some instances relieve the pain temporarily, however. In early localized septic infection, on the other hand, the primary pathological focus is in the part affected, and local dry hot air treatments will usually produce a rapid and radical cure; the organism at large will be secondarily benefited during the curative process, by the lessening of pain depression and of the quantity and virulence of the toxins elaborated in the original pathological focus, in direct proportion as the local lesion improves.

Summary of Physiological Influences.

General Application.—First, an immediate and powerful stimulation of the vital physical functions which is evidenced, before the patient leaves the apparatus usually, by augmented vigor of the heart action and pulse and a lessening of nervous erythism when such is present as a result of acute disease processes.

Second, a reflex stimulation of the functions of all the organs and tissues of the body which results in, *a*, a degree of elimination of urea and other katabolic excreta probably unequaled by that producible with any other measure now known; and, *b*, an amount of general reconstructive activity which would also seem to be in excess of that derivable from the use of other agents.

Local Application.—First, immediate relief of circulatory stasis.

Second, increased blood supply to the part treated.

Third, acceleration of the nutritive processes of the part due to reflex stimulation of the trophic nerve supply.

Fourth, an increase in the temperature of the part treated whereby the chemical reactions constituting local metabolism are facilitated. (It is probably through intensification of local physiological resistance, brought about by the four above-mentioned effects, that the inhibitive influence upon the development of pathogenic micro-organisms that may be present, is secured.)

Fifth, the withdrawal of a large amount of fluid from the part treated by reason of the profuse perspiration induced.

Clinical Applicability.

From the above it will be seen that the pathological conditions in the treatment of which dry hot air is useful, can be divided roughly into three groups. Although this division is entirely arbitrary, yet it will serve to furnish a bird's-eye view of the field of action, and may quicken comprehension of its applicability to different cases.

First, those disease conditions in which the essential primary pathology is strictly local and for the cure of which the local dry hot air application is sufficient; as illustrations may be mentioned sprains, local septic infection in its early stages, and many cases of rheumatism.

Second, cases wherein the essential primary pathology is local but resultant conditions in the organism at large have complicated the original symptom complex, and for the relief of which the additional influences of the body treatment upon the

general bodily functions must be invoked; local septic infection with profound systemic toxæmia is a good illustration of this class.

Third, the constitutional, diathetic, and general diseases, in which only the profoundly-acting influences of the body treatment upon general metabolism are of benefit. As illustrations may be mentioned Bright's disease of the kidneys, chronic true gout, and arthritis deformans.

Analogies.

It will be observed that the physiological action of dry hot air is made up of most of the integral elements which also combine to form the physiological actions of the various hydrotherapeutic procedures, electricity, mechanical vibratory stimulation, massage, etc., but that such elements as are common vary in the proportion of intensity with which they manifest themselves in the characteristic influences of these different remedial measures; hence in some directions dry hot air is more efficient than any of them. It is frequently advantageous, however, and as will be seen later sometimes necessary, to combine other elements of therapeusis, physiological, medicinal, and surgical, with dry hot air in order to accomplish certain results. None of them alone will do the work of several combined in many cases.

The mode of action of thermotherapeutical influences is also directly parallel with and immediately in the line of the normal physiological forces concerned in cell development and tissue reconstruction, hence the only pernicious after-effect to be guarded against is reaction from over-stimulation, the avoidance of which will be discussed in the succeeding chapter.

Fallacies.

As to Identity of the Influences Exerted by Hot and Cold Applications.—A belief is more or less current that the effects upon physiological function of degrees of heat and cold which depart from the normal body temperature to the same extent in their respective directions, are identical. This belief is based upon a conception of the physiological actions of such applica-

tions, which assumes that *irritation of nerve endings in the skin* constitutes the only factor involved.

If such were the case the above-mentioned belief would undoubtedly be true, but reflection shows the problem to be much more complicated. The gross physiological effects of either hot or cold applications are made up of at least three component influences; first, that obtaining through modifications of sensation (including psychic impressions); second, that obtaining through the reflexes; and third, that dependent upon the *direct, inherent, physical and chemical* results of heating or chilling body tissues. The gross physiological influence being a composite phenomenon therefore, the operation of factors that alter the nature of any of the elemental constituent influences, or change the proportionate prominence with which they enter into the combination, would necessarily modify the physiological result.

To convince oneself that a radical difference obtains as regards *sensation*, it is only necessary to immerse the hand or foot in water at 73° F., and after the member has fully recovered immerse it in water at 123° F. (nearly the extreme limit of temperature elevation at which contact with water can be tolerated), which is as much hotter than the normal as the former is colder; if the immersion is not maintained long enough to obtund sensibility the deduction will offer no difficulties.

Another discrepancy, suggested by the preceding paragraph, is that contact with water can be tolerated at a much greater departure from the normal body temperature, in the direction of cold than of heat; more than twice as great with the majority of individuals. This discrepancy involves not only sensation, but the actual physical, structural integrity of the tissues subjected to influence.

To demonstrate a substantial difference in *reflex* effects, immerse the feet of a person who is perspiring freely in water at 73° F. for a few seconds and note what a lessening in the emunctory process takes place; conversely, immerse the feet of a person who is not perspiring, in water at 123° F. and see the perspiration start.

A disparity in the *direct, inherent, physical* effects produced by actually chilling or heating body tissues, becomes at once apparent to anyone who has observed the different manner in which an incarcerated hernia responds to the two applications. Such a disparity is also well illustrated by the fact that superficial neuralgias and other painful conditions are sometimes relieved by hot compresses and aggravated by cold, and *vice versa.*

Nothing conclusive can be said as to the prominence of the first-mentioned factor as a modifying element; it has not yet been determined in just what degree or manner differences in sensation are active in influencing physiological function. We *do* know, however, that a remedial measure that is not unpleasant to the patient is likely to produce better results than one which *is* unpleasant, and the application of which is therefore anticipated by him with dread. The therapeutical application of dry hot air is very rarely unpleasant in the slightest degree, that of cold is not infrequently fraught with torture both mental and physical; patients usually look forward with pleasure to the former, and frequently with terror to the latter.

As regards the reflex tendencies of cold and heat, it is reasonable to infer from oft-observed clinical and experimental findings, that they are exerted in the *same directions* as are the direct and inherent effects; i. e., an application of cold would tend *primarily* to affect the metabolism and nervous phenomena of the area influenced as would cold if applied directly and long enough to chill the parts; an application of heat would tend *primarily* to affect the area influenced as would an actual raising of its temperature *en masse.*

The proposition stated in the foregoing paragraph assumes that neither the heat or the cold is applied with sufficient intensity to excite protest from the tissues under influence. The precipitation of protest would introduce the element of *irritation* into the equation, and the effects of pure and simple irritation are probably identical, whether provoked by either heat or cold.

The direct, inherent, physical effects of cold and heat may be indicated as follows:

First, chilling a body tends to *check* chemical changes going on among its component atoms; as applied to the human body the direct inherent effect would be to *hinder* metabolism, which involves cell and tissue reconstruction as well as destruction or waste.

Second, heating a body, on the contrary, tends to *facilitate* chemical changes going on among its component atoms; as applied to the human body the direct and inherent tendency would be to *accelerate* metabolism, which, again, involves cell and tissue reconstruction as well as destruction or waste.

Applying these principles practically, then, we find that the application of cold to the body brings into play a force which is antagonistic to normal metabolism and catabolism, nervous and glandular function, as represented by chemical change and the facility with which nerve impulses are transmitted. If the application is sufficiently intense, the organism will resist at the first impact; if contact is prolonged sufficiently to overcome this initial resistance, metabolic processes will be retarded in direct proportion as the tissues are chilled. After the inhibitory effect has passed away, the organism will endeavor to overcome or make up for the effects of temporary suspension of vital processes by temporarily increasing normal processes and functions; by manifesting *reaction.*

The stimulant influence of cold then, is constituted solely and entirely by this tendency toward resistance and reaction. hence the *degree* of stimulation obtainable with it is limited absolutely by the vitality, or power to resist such antagonistic influences, of the organism under treatment. If the organism is so weakened by disease or any other factor as to be unable to resist with a requisite degree of vigor, depression instead of stimulation will result.

The application of heat to the body, on the other hand, brings into play a force and induces conditions which are entirely in harmony with the normal processes, hence there will be no initial resistance and no temporary paralysis of metabolism which must be overcome before stimulation (reaction) sets in. Its influence, being inherently in harmony with normal metabolism, is accelerant to these processes, in some degree, from the

start and continues so to be throughout every phase of action contingent upon its sustained application.

When we recall that in the great majority of pathological conditions the human organism endeavors to rid itself of disability solely and entirely through accentuation of the normal metabolic processes, the deduction as to the relative applicabilities of cold and heat to such pathological conditions becomes immediately apparent.

Another important fact exhibiting a prominent therapeutical bearing and contingent upon the foregoing, is that cold is directly, inherently, and reflexly *inhibitive to elimination* as well as cell production and increases the former function only secondarily through the reaction obtainable, and that heat, on the contrary, is directly, inherently, and reflexly *accelerant* to elimination, primarily and throughout the whole period during which it may be applied.

The element most active in producing the immediate, visible *stimulation* of the vital signs obtainable with dry hot air, however, to apply the foregoing directly to our immediate subject, is irritation of the nerve-endings in the skin when the heat has become intense enough to excite protest (reaction) from the deep nerve centers. This protest, however, is not against an inherently antagonistic force which threatens inhibition and it has not been necessary to paralyze normal processes in order to elicit the reaction, hence it would be expected to act more kindly than cold. Further, this irritation of nerve-endings occurs late in the application and after the organism has been so influenced through acceleration of its vital processes as to be capable of more efficient reaction, as suggested in the preceding paragraphs; the gross stimulation obtainable with this agent therefore is much more profound than when cold is employed.

The inference, then, that the gross effects of cold and hot applications are identical is not demonstrable by experiment, confirmable by clinical experience, or defensible by any line of logic based upon observed physical or physiological facts. We are justified therefore in making the claim, suggested by practical experience, that radical differences exist and that they

demonstrate that dry hot air has a place in the treatment of disease that no other known measure can fill; that to secure the best therapeutical results these differences must be recognized, distinguished, and thoughtfully considered in connection with the management of different disease processes.

As to Identity of the Effects Producible with Dry Hot Air and Hydrotherapy.—The hydriatic modalities depend for the induction of their various influences upon the bringing into contact with the skin of different degrees of heat and cold through the medium of water variously manipulated. As far as the inherent effects of heat and cold are involved in hydrotherapeutic applications all that has been said in the preceding section applies equally well here, but, as has previously been stated, hydriatic and dry hot air applications are not directly comparable because practical difficulties render it impossible to apply the same degrees of treatment intensity; the conditions surrounding the use of these two remedial measures therefore are not susceptible of identification for purposes of comparison. Further, some hydriatic procedures include *percussion*, an element which has no parallel in any method of dry hot air therapy.

The practical difficulty which obtains in those hydrotherapeutical procedures involving heat consists of the fact that nothing like the same degree of treatment intensity can be applied to the skin through the medium of water as through the medium of air, because the structural integrity of this tissue is seriously endangered when the temperature of a wet application approaches 170° F. and the result of contact at 212° F. needs only to be mentioned to be appreciated. Air can safely be applied to the skin at 400° F. and sometimes more if proper precautions are observed, and its characteristic and most desirable effects are not produced at a temperature lower than 300° F.

The nearest approach to a parallel which dry hot air therapy can offer to percussive hydrotherapy is when a dry hot air treatment is followed by mechanical vibratory stimulation, and when the organism has had its metabolic and reflex activities intensified to such a degree as obtains after a dry hot air appli-

cation it would seem as though this combination would discount the hydriatic modality as regards intensity of both local and general influence; this, however, is a matter for future observation to decide.

As regards comparison of the effects of general cool and cold hydriatic applications and dry hot air, to the whole or the greater part of the body surface, no one who has ever contrasted the appearance of a typhoid patient, shivering, cyanosed, and with weakened pulse after a bath only fifteen or twenty degrees Fahrenheit below the body temperature, with that of such a patient who has been given a body dry hot air treatment, will any longer entertain doubt as to the existence of a radical difference in the gross effect of the two measures. The general dry hot air application never produces shivering or cyanosis with all that they imply, no matter whether it is administered at ten or three hundred degrees above the normal body temperature; on the contrary, the sedative influence upon the nervous system is invariably marked, the patient usually falling into a quiet sleep within two hours, and the ruddy glow of the skin, warmth of the extremities, and augmented volume and force of the pulse which ensue demonstrate that a direct and powerful sedative and tonic force has been at work.

The elucidation of the variation in these two pictures is found in the fact that the patient who is cyanosed and responding badly to the cold bath has not sufficient vitality to react adequately, while the influence and effect of the general dry hot air treatment are such that much less reactive power on the part of the patient is necessary for the production of its full effect; the thermal agent furnishes inherently and directly the greater part of the effect demanded.

No matter how carefully and conscientiously the hydrotherapeutic treatment of typhoid fever is carried out the above-described picture not infrequently obtains, and we have seen profound and alarming prostration follow twenty minutes of simple cold toweling of a patient in bed and which refused to yield to strychnia hypodermically, whisky, and vigorous rubbing, overcome at once by fifteen minutes of general dry hot air at 300° F.; a very good practical indication that the measures

exert radically different influences. In addition to this, typhoid patients sometimes complain bitterly of the hydriatic application, but I have never heard one object at all strenuously to the general dry hot air treatment; on the contrary, they usually like and feel comforted by it.

After what has been said in this and the preceding sections, a statement, which has been published, to the effect that dry hot air applications are "not complete except when systematically employed in conjunction with hydrotherapy," will need but brief discussion.

The profundity and intensity characterizing the acceleration of functional and general metabolic processes, evoked by a thoroughly-administred dry hot air treatment, is limited only by the inherent capacity of the organism under influence for carrying on these processes; hence they could not be further increased by the application of any other force acting from without the organism, and certainly not by a force which depended for its stimulating properties upon the reactive capacity of such organism. If the dry hot air were not intelligently and thoroughly administered (as when the degree of heat employed is not sufficiently intense, etc.) and if the patient's reactive powers were adequate it would be obvious that the application of an additional stimulant would be beneficial; when shortcomings in technique are eliminated, however, dry hot air rarely, if ever, needs to be followed by hydrotherapy in order that its beneficent work may be complete.

This does not mean, however, that hydrotherapy is not of value, and of great value, when combined (alternated) with dry hot air applications; on the contrary, in some conditions such employment of hydriatic measures is of the greatest assistance.

As to the Rationale of Its Physiological Influences.—One of the most prevalent errors in the popular conception of the *modus operandi* of the curative powers of dry hot air, is that it produces its effects merely through the induction of integumental hyperæmia and toxin elimination as represented by profuse perspiration; this has led to applying the agent at temperatures only sufficiently high to produce sweating, that is, from 200° to 250° F. By this means elimination has been se-

cured, and very effective elimination, too, as far as the perspiratory function was concerned, but that was all. Now to obtain the most profound and permanent curative influences of dry hot air, we must not only induce elimination but supplement and perpetuate as far as possible the advantage dependent thereon, by augmenting the trophic reconstructive functions whereby we increase the patient's constitutional resistance; and effective stimulation of these processes is not possible unless the higher temperatures, from 300° to 400° F., are used.

As to Permanence of Results.—One commonly hears it stated that the curative results obtainable by the use of dry hot air are not permanent. This criticism is largely based upon the belief that dry hot air is only a palliative measure, like a dose of morphine in painful conditions, for instance, and would never be entertained if the profound influences upon physiological function which we have been discussing were given due consideration. The belief was originally given weight by the observation that cases of rheumatism treated with dry hot air *alone* very frequently "came back," but this merely meant that the disease was not cured because the thermal agent was not properly supported by the simultaneous administration of appropriate drugs in appropriate dosage. The therapeutical characteristics exhibited by dry hot air consist in its power to accomplish, either alone or in combination with other indicated agents, that which it is impossible for any other combination of agents to accomplish without its aid.

Another fact bearing upon this criticism is that when we have carried a patient through an attack of pneumonia, typhoid, rheumatism, or any other disease, except where the ætiological factor has been removed surgically, we cannot assure him that he will never have the disease again, no matter what curative agents we have employed. We can only be certain that this one attack has been extinguished. If appropriate environmental and constitutional conditions again obtain he will surely have to sustain another attack, no matter how perfect may have been his health in the meantime. When men no longer contend with conditions which engender habits of life that are inconsistent

with their perfect physical health, then, and not till then, shall we be immune from repeated attacks of disease, and when that millennium has arrived, dry hot air.and most of our other remedial agents will have retired to the oblivion of complete desuetude.

In closing the consideration of this division of our subject I desire to emphasize the fact that the key to the attainment of satisfactory results by the use of dry hot air as a therapeutic agent is the same as with any other remedial measure, medicinal or otherwise, viz., a thorough knowledge of the physiological action of the agent, and a logical consideration of the same with reference to the pathology of the individual departure from the normal for which a remedy is being sought.

CHAPTER III.

TECHNIQUE.

THE difference between proper, thorough technique, and the reverse, frequently constitutes the difference between success and failure in clinical results; hence this subject is a very important one and merits close study.

The current idea that it is a perfectly easy matter for *any* physician to secure a dry hot air apparatus and successfully treat his patient, without any special knowledge of the agent or the management of it with reference to different pathological conditions, is entirely erroneous and much to be deplored. When this unfortunate impression has been eliminated better results may be looked for from its general employment, and appreciation of its beneficent powers will succeed the lack of confidence with which it is so frequently regarded at present. Inefficient technique, and lack of adequate familiarity with its physiological action and clinical possibilities, whereby it has been called upon to produce results which a reasonable degree of enlightenment upon these points would have taught should never have been expected of it, have brought upon dry hot air a vast deal of undeserved opprobrium.

Methods of Preparation.—There are two ways of giving treatments; with coverings and without.

The latter method is based upon the assumption that the perspiration will be evaporated off from the skin by the high degree of heat as soon as it is formed; while this should perhaps be so theoretically, yet experience demonstrates that it does not always take place. A large proportion of the perspiration *does* evaporate immediately, and if a low degree of heat (200° to 250° F.) is used, the administration without coverings is very satisfactory. But it is ordinarily necessary to employ greater intensities (350° to 450° F.) and then the sweat-glands

functionate so copiously that the secretion is not all vaporized immediately and the residue becomes hot enough to blister.

Employment of the covering obviates this danger; as it invests the skin closely the perspiration is absorbed by it as fast as it collects and the attenuation of the secretion effected by distributing it through the meshes of the fabric facilitates its conversion into steam by the heat, when it readily diffuses off into the air surrounding the part under treatment.

The material for the covering should be loose-meshed and as absorbent as possible, and the cheap grades of Turkish toweling have given me greater satisfaction than anything else.

It has been urged as an objection against the use of wrappings, that the heat would be dissipated by its passage through them to such an extent that although the treatment could be applied at a much higher temperature than when they were not used, yet the layers of air in immediate contact with the skin would not exhibit a temperature in excess of that which it would be possible to apply if the application were made to the bare skin. To dispose of the point it is only necessary to insert a high-temperature thermometer between the layers of the wrapping during a treatment, remove it quickly, and note the reading. Again, anyone who has observed the methods when given side by side cannot fail to be impressed by the variation obtaining, both as regards therapeutical influence and the comfort of the patient.

LOCAL APPLICATION.

Preparation.

It is well to have the patient remove all of his clothing and don a flannelette robe or suit of pajamas in which to undergo this treatment; he is thereby enabled to go home in dry garments instead of those dampened by perspiration.

Arms and Legs.—For treating these members and portions thereof the Turkish toweling should be cut into strips about seven inches wide and five feet long, hemmed and rolled like a surgical bandage. It is applied the same as a roller bandage

(Cut X), not tightly, but closely enough to obtain even and intimate contact between it and the skin.

There should then be wound about it, paying especial attention to the creases and recesses, a line of tape with the turns about one inch apart (Cuts XI and XII); this will press the toweling down upon the skin where the original application of the wrapping has failed to do so, making the contact as perfect as possible.

The limb is then ready to be placed in the apparatus, after which *it should be again carefully inspected to see that everything is in proper position before the heat is turned on.*

Knee.—At first sight the apparatus designed especially for treating this joint would seem to be particularly well adapted for its purpose, but when it is attempted to utilize it practical difficulties present themselves.

In this machine the leg is supported by a canvas or denim strip passing from side to side in the interior of the hot air reservoir, upon which it is designed that the posterior surface of the joint shall rest. It will be found that when the perspiration starts it will run down and soak into the wrapping next to the popliteal space, and will be confined there by the pressure of the canvas strip under the weight of the leg. Instead of being rapidly diffused off into the air in the cylinder it remains in contact with the skin, and the constant steaming produced will render it impossible to secure the desired intensity of heat without blistering.

It was attempted to obviate the difficulty by having two vertical supports made, one to be placed at the distal and the other at the proximal end of the apparatus and entirely external to it, upon which the leg should rest. By this means it was possible to do away with the supporting strip inside of the reservoir and the conditions were considerably improved; blistering was still uncomfortably frequent, however. Finally, the special knee apparatus was discarded altogether and the general local machine substituted with eminently satisfactory results; much better in fact than those obtained with the one especially designed for the joint (Cuts XII and XIII).

Other advantages dependent upon treating the whole of the

X.—Applying Turkish-Toweling Strips Preparatory to Local Application of Dry Hot Air to Knee with Special Knee Apparatus.

XI. Patient Prepared for Local Application of Dry Hot Air to Knee with Special Knee Apparatus.

XII.—Patient Prepared for Local Application of Dry Hot Air to Leg from Knee Downward.

XIII.—Local Application of Dry Hot Air to Leg from Knee Downward with Betz General Local Apparatus.

XIV.—Local Application of Dry Hot Air to Knee with Betz Special Knee Apparatus.

limb below the knee as well as the joint itself, are, first, the greater amount of reflex trophic influence obtained by reason of the greater area of skin exposed, whereby the total number of nerve-endings stimulated is increased two- to three-fold; and second, the greater rise of temperature producible in the tissues about the joint, hence greater acceleration of metabolism, through the heating of the entire return circulation from the toes upward.

Knee joints which it is desired to treat with dry hot air, however, are sometimes ankylosed in the flexed position, which renders it impossible to get the joint into the general local apparatus; that specially designed for the knee then becomes the only one available.

The joint is wrapped with three thicknesses of Turkish-toweling strips for a distance of ten inches above the patellar and the same distance below this point (Cut XI). The foot is then carried through the cylinder until the knee joint is directly above the source of heat and resting upon the hammock. The flexible attachment for closing the distal end is fastened about the limb six or eight inches below the knee and that for the proximal end at the same distance above (Cut XIV). The heat is then turned on and run up as high as the patient's tolerance will permit, but for the reasons just stated this will rarely be more than 275° F.; this degree of heat is much less efficient than 350° F. and not infrequently it will fail altogether in producing the desired therapeutical result.

The fact that an efficient special knee apparatus is not at present available, however, is not of as much importance as would at first be supposed. The class of arthritic affections in which the general local apparatus cannot be used for treating this joint is, as will be seen later, that in which local repair is best obtained through restorative influence exerted upon the general system, and the body treatment renders the use of local applications unnecessary.

When the shoulder, hip, abdomen, lung, or lumbar region is to constitute the field of operation the toweling should be cut in pieces eighteen or twenty inches wide and five feet long; when folded twice so as to make three thicknesses such a piece

presents an area that is very convenient for use in this situation. It is also well to have on hand three or four pieces of toweling about eighteen inches square for use with those patients who require but a single thickness of the wrappings.

Shoulder.—When adjusting the wrapping to this region it will be found advantageous to locate it diagonally with a corner pointed down the arm (Cuts XV and XVI) and to commence the winding of the retaining tape at the lower end.

Although tape does very well for retaining the wrapping in this location yet it will be found that cloth straps one inch wide, furnished with a buckle at one end, and about five feet long will be found more satisfactory in most cases. After the wrapping has been located as above, such a strap is passed around the body immediately below the armpits so as to include that portion of the wrapping which is folded under the axilla, and buckled so that the buckle is posterior and opposite the median line of the back between the shoulder blades. The free end of the strap is then brought over the wrapping on the shoulder close to the root of the neck and pinned to that portion of the strap which passes over the sternum. The edges of the wrapping about the upper arm are then drawn together upon the inner side of the arm midway between the axilla and the elbow and pinned together with a safety pin (Cut XVI). By this means, slight, uniform tension is exerted upon the wrapping all over the area to be treated and in all directions, and no constriction of the blood-vessels or other uncomfortable sensations will annoy the patient.

As with the knee joint a better therapeutic result can be attained if the whole arm as well as the shoulder is subjected to influence and the entire return circulation of the arm heated. When deformities or motile limitation from pain is not present in such a degree as to prevent carrying the arm away from the body so as to get it into the cylinder therefore, the wrappings used should consist of the strips and their application should commence at the finger tips and be extended to the neck. The proximal end of the cloth attachment should then be adjusted to the patient sufficiently high up to include the shoulder, and the arm rested upon the hammock inside of the apparatus.

The special chair devised by the author and described in Chapter I will be found very helpful when administering a treatment to the shoulder.

Hip.—The same suggestion as to placing the wrapping applies when the hip is being prepared for treatment, and in this situation also the cloth straps described in connection with preparation of the shoulder will be found better than tape for holding the toweling in place (Cuts XVIII and XIX).

Treatment is most conveniently administered with the patient lying on his side upon a couch, the hip to be treated being uppermost.

Abdomen.—The patient is brought to the edge of the bed, the wrapping placed upon the abdomen, and retained in place by webbing straps one inch broad, long enough to pass clear around the body, and furnished with a buckle at one end; these are passed about the body one just above another just below the iliac crests.

The patient is then turned upon his side facing outwardly from the bed and a pillow placed under the lumbar region, so as to prevent the sagging of this portion of the body due to the projection of the undermost iliac crest.

When this position has been attained it will be found that the webbing straps will require readjustment in order that good apposition of toweling and skin may be maintained. It will also be found that the sagging of the abdomen due to the position has caused a hollow to form immediately under the uppermost iliac spine, into which the toweling will have to be pressed by crowding a napkin under the retaining strap in this situation (Cuts XXVII and XXVIII).

This hollow must be carefully watched during treatment and the covering frequently pressed down upon the skin by the hand of the operator, or blisters will sometimes form in spite of the napkin.

The Chest Wall and Lumbar Region.—The cloth straps used in the abdominal operation constitute the most efficient means of maintaining the necessary contact between wrapping and skin when treatment is to be applied over the lungs or the lumbar region (Cuts XX, XXI, and XXIII).

When the chest wall of a woman is to be treated one of the retaining straps should be passed around the body directly under the breast, so as to press the toweling well down into the hollow formed by the projection of this part of her anatomy. It will be wise to press the toweling frequently against the skin in this situation anyway during the séance, as the occasional impossibility of securing close contact here, even with a well-applied belt, invites a tendency toward blister formation.

Amount of Wrapping Necessary.—Just the right amount of covering to be employed will be determined by the idiosyncrasy of the individual patient as regards profuseness of perspiration, and of the treatment as regards the intensity of heat, etc., but should be as little as is consistent with safety of the integument. At least one thickness, however, should cover every part of the area exposed, and the wrappings should be boiled in soap and water after each application.

Apparatus.—When the Betz general local apparatus is employed particular care should be exercised to see that the heat carrier entirely covers the hole in the bottom of the cylinder through which the hot air enters, before the treatment is started. It is very liable to become displaced when the machine is moved and when displaced the thermometer reading is absolutely unreliable as an index to treatment intensity; further, the proper distribution of heat to all parts of the apparatus is seriously interfered with by such displacement.

When treating portions of the body other than the extremities, the supporting hammock inside of the apparatus is of no utility and had better be removed from the machine altogether.

Administration.

After the wrappings have been applied the cloth attachment appropriate to the region which is to be treated should be adjusted, *first to the patient* and then to the apparatus, and the heat turned on.

The office of the operator during the treatment resolves itself into four functions, as follow:

First, attaining, and steadily maintaining a temperature in the apparatus, of appropriate elevation.

XV.—Position of Covering Preparatory to Adjustment for Local Dry Hot Air Application to Shoulder.

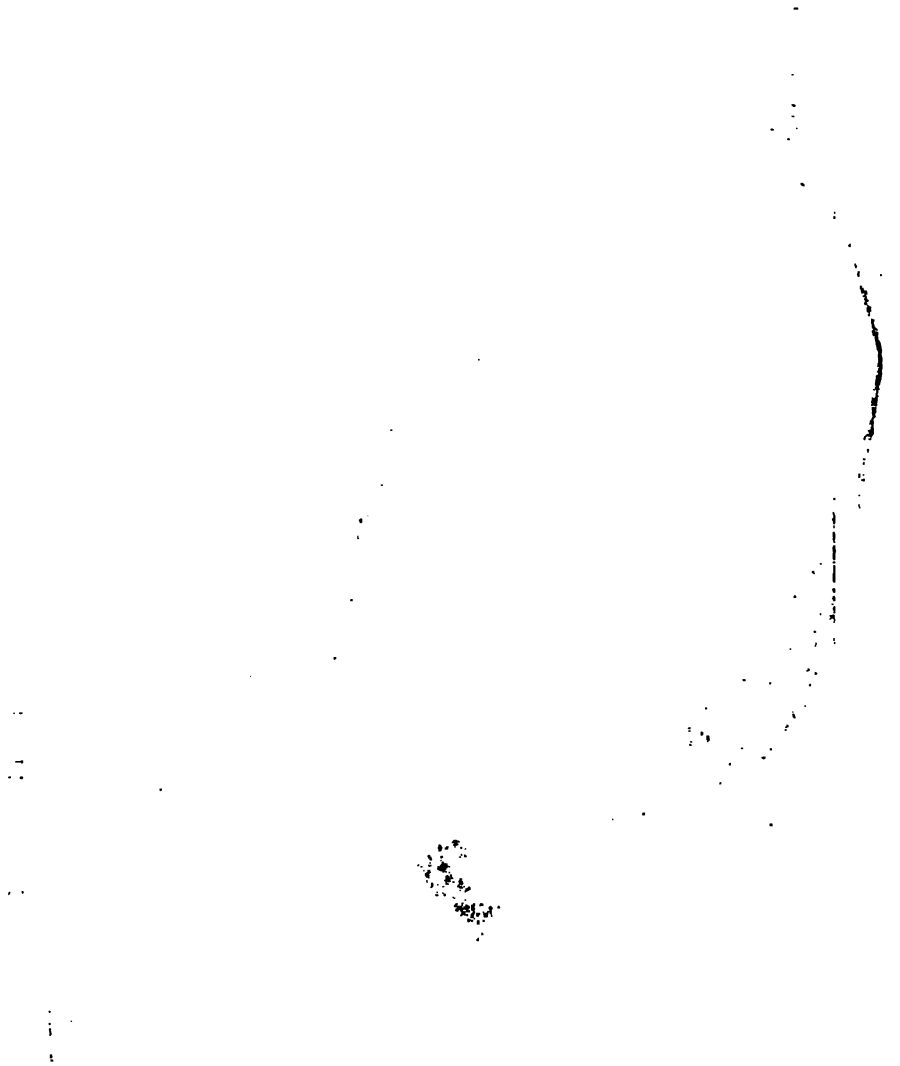
XVI.—Shoulder Prepared for Local Dry Hot Air Application.

XVII.—Local Dry Hot Air Application to Shoulder.

XVIII.—Hip Prepared for Local Dry Hot Air Application.

XIX.—Local Dry Hot Air Application to Hip.

XX.—Local Dry Hot Air Application to Lumbar and Sacral Regions.



XXI.—Patient Prepared for Local Dry Hot Air Application to Left Lung or Pleuræ.

Second, changing the air in the cylinder often enough to maintain dryness.

Third, guarding against ignition of the wrappings and cloth fittings of the apparatus.

Fourth, preventing blister formation.

Accomplishment of the first involves merely allowing the temperature to rise steadily until the desired intensity is reached, where it may be maintained by regulating the heat supply.

As regards the second, introducing the heated air directly into the cold cylinder will provoke condensation of moisture to such an extent as to necessitate complete ventilation about once every three minutes during the first quarter of an hour. The little valve in the top of the cylinder is not large enough to accomplish this efficiently at this stage of the application and the object is best attained, unless the valve has been enlarged as described in Chapter I, by slipping from the cylinder that portion of the cloth attachment which encircles its upper segment, replacing it again after a few seconds when the air emerges dry. After the machine has become thoroughly heated no more inconvenience will be encountered from this source, and opening the valve in the top of the cylinder occasionally for a minute or two will effect all the ventilation necessary.

The best method of accomplishing the third object is to smell occasionally of the air that escapes from the cylinder during ventilation; the odor of scorching cloth will be detectable if danger is imminent.

If the cloth does ignite the first thing to do is to turn off the heat, then remove the patient's limb from the apparatus and dispose of the smoldering fabric. If the mischief is taken in hand as soon as the odor of combustion is detectable there will be ample time in which to eliminate the difficulty before serious results are precipitated.

Attainment of the fourth object will be facilitated if the conditions favoring blister formation are borne in mind, as follow:

First, the presence of an excessive degree of moisture in the air contained in the cylinder.

Second, failure in maintenance of even and intimate contact between covering and skin, due to inefficient application of the wrapping in the first place, or to movements which have caused wrinkles to form, on the part of the patient. Perspiration collects upon areas of skin not in contact with the absorbent, and its temperature rapidly rises toward the boiling point.

Third, interference with free circulation of body fluids in the part under treatment, as by undue tightness of the wrappings, sclerotic changes in the vascular structures, etc.

Unless some condition of the patient's tissues is present whereby sensibility is obtunded, a threatening blister will cause him to complain of a "burning" sensation; the remedial procedures to be employed when such warning obtains, then, would be as follow:

First, ventilate the cylinder rapidly by separating from it the upper portion of the cloth attachment; if this procedure does not remove the discomfort in a few seconds the first-mentioned causative condition is not involved.

Second, introduce the hand into the apparatus and press the toweling down upon the complaining area of skin, when immediate absorption of scalding sweat, and relief if the trouble is due to this factor, will follow.

It requires a little practice to execute this maneuver without burning one's hand; the knack consists in getting the hand in on to the part quickly, and quickly out again without touching the sides of the cylinder. It is wise for a beginner to wear a cloth glove during this and the next-mentioned procedure; it will save him much discomfort and some blisters of his own.

Third, introduce the hand into the cylinder and loosen the wrappings about the complaining region; if they are too firmly fixed to be susceptible of requisite manipulation in this way, remove the limb from the apparatus and the wrappings from the limb and reapply them more loosely.

When sclerotic changes constitute the offending element soaking the sensitive areas in moderately hot water for ten minutes before treatment, as recommended by Ringer, is the only efficient remedy with which I am acquainted. If this does

not obviate the difficulty it will be necessary to treat the patient with a lower degree of heat: individuals exhibiting gangrenous tendencies cannot safely be subjected to more than 200° F. usually.

Duration and Intensity of Séance.—The local treatment lasts an hour usually; less than this is not enough, and more does not increase the effect under ordinary circumstances.

The intensity demanded will vary from 300° F. to 400° F., rarely more or less.

Both duration and intensity will vary according to the conditions obtaining in the individual case, and will be discussed in their relation to different pathological states in the sections which treat of these states.

After-Care.—Wiping the perspiration from the part treated with a dry towel is all that is required under ordinary circumstances. Wrapping the part in flannel or cotton, as is sometimes recommended, is very rarely called for. Conditions exceptional to these rules will be so noted in the sections which treat of the diseases in which they occur.

External Auditory Canal.

The writer has had no personal experience with the use of dry hot air in this region, and the following description of the technique pertaining to the Hopkins generators, is taken verbatim from one of the inventor's articles upon the subject.

Management of the Apparatus.—"(1) When the appliance becomes hot and exit is through a small opening, as in an ear-tip, the temperature of the air is proportional to the rate of flow, or degree of air pressure. Strange as it may seem, the air temperature may be increased one hundred degrees by increasing the pressure five pounds, or conversely, the temperature may be decreased by lowering the pressure. This fact enables us to regulate the temperature at will by merely increasing or decreasing the volume of air entering the cylinder.

"(2) The air temperature drops very rapidly after the air leaves the exit-nozzle, and in order to secure the maximum heat the part under treatment must be as near the nozzle as possible

and still allow room for escape of the used air, if a cavity like the ear is under treatment.

Preparation of the Patient.—" The ear selected for treatment is carefully examined and found to be perfectly clean and dry. A light pad of gauze (two thicknesses) is placed over the ear and with an ear speculum the gauze is pressed deeply into the canal, leaving only room enough between the tip and the tympanum for the escape of the used air.

Administration.—" The electricity is then turned on, or the gas ignited (as the case may be) and the compressed air is admitted to the cylinder under about five pounds' pressure. It is well to give a ten or fifteen minutes' séance, increasing the temperature gradually until the limit of toleration is reached. The temperature steadily increases until the heater reaches its generating limit at that air-pressure, and if the patient tolerates the temperature well it may be further increased by raising the air pressure to seven, eight, or even ten pounds, in most cases. One cannot be guided by thermometers in giving these treatments, and hence they are not employed on the new heater described. The only guide which can safely be followed is the individual toleration of the patient. But it is well to remember that the more slowly the temperature is raised the higher temperature the patient can endure without discomfort."

" Treatments are best given three times a week for from three to twelve months."

GENERAL APPLICATION.

Preparation.

A loose bath-robe made of Turkish toweling constitutes the best covering to use during the body treatment.

The patient may assume any position agreeable to him, but as it is necessary that he remain quiet and not move his limbs about during the application, lying upon the back is preferable unless deformities are present which render the position irksome.

Small pillows are placed under the hollow parts of the body so as to give it support without strain.

XXII.—Patient Prepared for Body Dry Hot Air Treatment with the Betz Body Apparatus.

Boots made of the same material as the robe and coming to the knees are pulled on over the feet; if the hands are to be included in the application they should be encased in mittens of Turkish toweling.

The robe is then pressed down between the legs and arranged so as to hug the skin closely, and the patient directed not to move his legs about after this has been done.

Enough medium-sized Turkish towels are then spread over the feet, legs, and abdomen to form three thicknesses, the apparatus closed by dropping the curtain or curtains, and tucking them in closely about the patient. The inside of the apparatus should then be inspected to see that no towel or other inflammable object has dropped into it, and the heat turned on.

Just the right amount of covering to be used will be determined by the idiosyncrasy of the patient as regards profuseness of perspiration and nervous sensibility, and of the apparatus as regards the degree of heat used in the treatment, etc., but should be as little as is consistent with the safety of the integument. Very frequently the robe alone, which constitutes one thickness, will be sufficient; in other cases it will be necessary to cover a portion only of the body, as the feet, abdomen, or thighs, with the extra towels. The patient's sensations are a pretty safe guide in the matter.

Administration.

The body area exposed to the heat should usually be the feet, legs, and abdomen up to a point midway between the umbilicus and the nipple line, but it may be extended so as to embrace the whole body up to the neck. The factor which determines whether or not the whole body up to the neck shall be subjected to influence is the degree of response obtained from the nerve centers during the séance, and this also governs the length and intensity of the application.

Different individuals exhibit different degrees of susceptibility to thermic stimulation and each patient must be handled according to his own law. Observation and experience have shown that this factor is tangibly and conveniently expressed under ordinary circumstances by the degree of acceleration of

the pulse and increase in the body temperature which, as we have seen in the preceding chapter, accompany its application. The modifications in the character of the respiratory function exhibit too much irregularity to be of value as indices of responsiveness to stimulation.

The pulse and temperature then being adopted as guides, it becomes necessary to know the *degree* of acceleration and increase, respectively, which must be attained in order that the amount of deep reflex response which will produce the best results may be known to have been induced, and from a study of four thousand body treatments given under my personal supervision I have adopted, as a working rule, the plan of treating the patient until his pulse-rate has increased to 120 beats per minute, or his mouth temperature is 2 degrees F. above the normal. One of these modifications will be attained first in one patient and the other in the next perhaps, but the attainment of either one usually means that a sufficient influence has been secured and that the time has come to stop the treatment. This rule is of course subject to modification according to the conditions surrounding the individual case.

I will say here that the mere induction of perspiration, however profuse, is not an indication that a requisite degree of influence has been secured; comparatively low degrees of heat will often do this. What we want is the *deep reflex response,* hence the necessity for intelligently thorough treatment. Patients not treated up to this point do not get their due in the way of benefit, and if it is carried much farther the nervous system ordinarily shows signs of over-stimulation which is nearly as bad.

Sometimes the application will be completed in fifteen minutes, sometimes it will require an hour.

When acceleration of pulse and increase of body temperature are already present, as with some acute febrile conditions, this rule, of course, possesses no value and the general effect upon the patient's nervous system must govern duration and intensity, care being taken not to over-stimulate.

Phenomena sometimes induced during treatment and which demand attention are nausea or retching, faintness, laryngeal

cough, oppression of breathing, headache, cranial throbbing, ringing in the ears, uncertainty or partial loss of vision, and mental confusion. The first four are evidences of hyper-excitability of the nerve-centers and are ordinarily met with only in hysterical subjects; the occurrence of the others indicates cerebral congestion and usually means that the limit of treatment duration and intensity, consistent with the patient's best good, has been reached. All of these phenomena are evidences of relatively excessive stimulation.

The remedy consists of the application of an ice-cap to the patient's head, which, with moderate fanning of the exposed portions of the body, will usually take care of the situation perfectly. If the symptoms persist in spite of these remedies the heat should be turned off, the patient cooled, and at the next séance the temperature should be run up more slowly. I have seen but one patient who could not take the limit if handled well and he was a victim of angina pectoris; the pain was always provoked when the pulse-rate reached 110, but it also always subsided kindly as soon as the heat was turned off and the pulse-rate had lessened.

Water may be given at any time during the treatment in dessert-spoonful doses every thirty seconds if the patient develops thirst, but should not be administered in large quantities at once.

Prevention of Accidents.—As regards scalds, burns, etc., the same causative factors, cautions, and means of prevention apply here as were mentioned when administration of the local application was considered, and to avoid repetition the reader is referred to that section for this information. If changing the air or pressing the covering against the skin does not relieve the burning sensation, open up the apparatus and spread another towel over the complaining spot. No matter what apparatus is used, if the heat is intense enough blisters are liable to obtain, and constant care should invariably be exercised.

The management of the toes during a body treatment, however, sometimes assumes a prominence which renders it worthy of special mention. The first thing to do when a patient complains of discomfort affecting these members is to change the

air in the apparatus, which will dispose of whatever steam may have collected, and direct the patient to move his toes gently backward and forward against the wrappings, but without raising his heels or knees from the couch.

If this procedure does not remove the difficulty, open up the apparatus and loosen the wrappings about the suffering members; this measure will always prove effective unless some mechanical interference with the circulation of the parts, such as atheroma, sustains a causative relation.

If the last-mentioned causation is responsible, soaking the feet in moderately hot water for ten minutes immediately before treatment, as recommended by Ringer, will sometimes prevent the annoying sensation.

If it persists in spite of the use of all of these measures, however, it will be necessary to resort to the radical plan of treating the patient with his feet outside of the cylinder entirely, the curtains closing the pedal end being tucked closely about his ankles.

Leaving the feet outside does not detract in the least from the efficiency of the treatment even when the disease process is located in these members. As has been stated when considering the physiological action of the body treatment, its influence "is predominantly reflex through the sympathetic and spinal nerve centers," hence the profundity of that influence is directly proportional to the number of nerve-endings exposed to the thermal stimulation; the number of those present in the skin of the feet bears such a small proportion to the number present in the skin of the rest of the body that practically it may safely be disregarded in this connection. Clinically I have never been able to perceive that it made any difference whether the feet were inside or outside of the apparatus, except in so far as that it was possible to treat the hyper-sensitive patient with a higher degree of heat when the feet were outside, hence modification of metabolism was more marked.

With patients in whom atheroma is present, and is threatening, or has already eventuated in gangrene, the desirability of preserving the toes from blistering is urgent. Under these conditions any traumatic solution of integrity in threatened

tissues is liable to inaugurate the gangrenous process, and my appreciation of that fact has been rendered poignant from having had the misfortune to see it demonstrated in my own practice. A man seventy years old was under treatment for extensive senile gangrene of one foot, the other being unaffected. The great toe of the sound foot was blistered while undergoing a body treatment at 300° F., and gangrene became established in the blistered area in about a week; this experience led me to adopt the practice of never treating the feet of a patient exhibiting gangrenous tendencies at a temperature exceeding 200° F.

I have seen patients with such tendencies in whom sensibility was so obtunded that they would blister without having experienced the warning of discomfort at all, hence it is very necessary to handle these cases with the utmost circumspection. It is, however, very desirable to induce the full physiological effect of the measure upon them and leaving the feet outside renders it possible to apply the agent as energetically as may be desired. The other portions of the body never give trouble of this sort that cannot be overcome in some of the ways previously suggested.

Intensity and Duration of Séance.—It is believed by some operators that as long as the requisite increase in the body temperature and acceleration of the pulse-rate are secured, it does not matter, as far as the therapeutical effect is concerned, whether the patient is treated for a long period of time with a low degree of heat(250° F.) or for a short period with a high intensity (375° F.).

The writer's experience has not led him to concur in this conclusion, neither does it seem to him that the philosophy of the position is well founded. Experience shows that exposure to a low degree of heat (200° to 250° F.) requires a much longer time in which to produce the requisite modifications in the body temperature and pulse in the majority of cases, and that in some it is absolutely impossible to attain them at all with low intensities. It also shows that physical exhaustion which sometimes lasts for many hours not infrequently follows treatment so administered. Further, those who advocate this form

of administration also advocate following the dry hot air application with a cold douche, which indicates that a satisfactory degree of vital stimulation does not ordinarily result from the long exposure to a low degree of heat. It is also this class of observers principally who incline to the belief that the beneficial effect of dry hot air applications is confined to the results of hyperidrosis and superficial hyperæmia.

On the other hand, when the treatment of high intensity is used, the requisite degree of modification in the physiological phenomena is attainable in about half the time required by the reverse procedure, and it is almost never impossible to secure this requisite degree of modification. Instead of physical exhaustion following the treatment we nearly always observe a marked exhilaration which lasts for hours and renders the use of the cold douche entirely superfluous.

As far as actual acceleration of the bodily metabolism is concerned, and entirely aside from the patient's subjective sensations, I would say that the comparative determinations as regards the urinary constituents made by us up to the present time, indicate a constantly greater degree as resulting from the use of the higher temperature with shorter exposure.

If the increased oxidation in the tissues of the body was solely dependent upon the actual increase in its temperature *en masse* effected by the dry hot air application, then of course the long exposure and low intensity of heat would produce the same acceleration of metabolism as the short exposure and high intensity, provided that the exposure to the low degree of heat was continued long enough to increase the body temperature to the same extent; because of the greater total length of time during which *some* elevation of the body temperature would necessariiy be sustained under the latter method, it might be even greater.

But it must be borne in mind that this is only one element in the equation, and that probably by far the greater portion of the increase in oxidation (metabolism) is due to reflex stimulation of the spinal nerve centers through thermic irritation of the nerve-endings in the skin. Through this stimulation is secured an augmented functionation of the organs and

tissues in which the spinal distributions ramify, hence that form of treatment which effects the greater stimulation ought to produce the greater degree of metabolic acceleration; the observations of the writer would indicate that the application of short duration and high intensity did both.

The difference in the effects of these two methods of application can scarcely fail to make itself evident as a difference in the influence secured upon the trophic and glandular functions and the physiological resistance of the patient, and this variation would be important in proportion as the necessity for sharply-defined influence was urgent. In pneumonia, profound septic infection, Bright's disease, etc., the question would assume an aspect of prominence; it has therefore been considered of sufficient moment to justify discussion at some length.

After-Care.—The management of a patient who has had a thorough body treatment is somewhat important. Our custom is to leave him in the closed apparatus for ten minutes after stopping the heat, then open up the apparatus and allow him to cool, exposed to the air of the room, for twenty minutes. Usually by this time the body temperature and pulse will have returned to the normal. The pulse usually subsides more slowly than the temperature, but the patient should not be allowed to rise until it has nearly or quite reached the rate which obtained before treatment, or syncope is liable to result. One of my early patients frightened me sorely before I had learned this point, by falling in a heap on the floor, unconscious and cyanosed, on her way from the apparatus to the bath; I had gotten her up too soon.

When the pulse has subsided the patient may rise to the sitting posture and see if the exertion causes nausea, faintness, or giddiness; if it does he should lie down again for ten minutes more. If not, he may slowly and deliberately leave the apparatus and sit in a chair, preferably one which can be instantly adjusted to the reclining position if any giddiness or nausea is provoked. If no untoward symptoms appear within three or four minutes he is ready to be taken to the tepid bath, well soaped, rinsed and put to bed. He should then have a

thorough rubbing with alcohol and be left to sleep or rest for an hour, after which he may dress.

With patients who are unable to get up and about, the bath will, of course, have to take the form of a " sponge " and may be given either upon the couch of the apparatus or after the patient has been removed to his bed. The sole object of the soap and water bath is removal of the perspiratory accumulations; the alcohol rub which follows is locally stimulant and generally comforting.

In some diseases characterized by a marked element of nervous debility, as arthritis deformans and various neurasthenic conditions, it is well to prolong the period of rest following the alcohol rub to three or four hours.

In General.

Frequency of Administration.—This factor varies with different diseases and conditions and will be indicated, together with advantageous modifications of the technique, in the sections which treat of these diseases.

Intermissions in Treatment.—In chronic diseases, as arthritis deformans or chronic nephritis, it is desirable to suspend active treatment at intervals after the patient has once been gotten thoroughly under influence, and allow his natural vital powers to carry on their work of their own stimulated volition as long as recuperative ability is manifest. In the majority of disease processes a patient is able to recover his health only through the agency and by the exercise of these powers, and dry hot air applications simply augment them, thereby investing the various elements of the organism with the capacity for more vigorous functionation. After such functional augmentation has once been induced then, it is just as well to let matters alone until the physiological processes manifest the need of more help.

Most patients are also susceptible of being benefited by a change in their surroundings when such change does not involve disagreeable or detrimental conditions, and when one has been treated in a sanitarium for weeks or months, as many of them will have to be if they get the most out of the thera-

peutical régime, a subjection to different psychological influences will frequently do much to intensify and perpetuate the restorative tendencies of the actively-applied remedial measures.

Burns.—A proper acquaintance with the technique and adequate attention paid to its execution, will render severe burns, scalds, or other grave accidents entirely unnecessary of induction under all ordinary circumstances. Such lesions as do occur present no pathological features not present in the common blister except that they are usually considerably deeper; ordinary surgical treatment is all that it is necessary to apply for their cure.

Contra-Indications.

This phase of our subject will have to be investigated further, clinically, before much can be said of it. As we have seen, the influence of this agent under judicious administration consists of a pure and simple stimulation of normal physiological processes without pernicious reactive manifestations, which therefore results merely in accentuation of normal metabolism and of the natural constitutional resistance against agencies or conditions which threaten the well-being of the organism. Theoretically, then, it would seem that it ought, upon general principles, to be useful in almost any pathological condition characterized by impairment of physiological function; practically, in our own experience, the inference has appeared to be very well justified, almost no contra-indications that would stand the test of clinical investigation having been ascertained.

Malignant disease would seem to offer an unfavorable field for exercise of the activities of the local application because of the effect of such activities in stimulating cell growth; I know of no clinical data that furnish reliable information upon this point, however.

A recent cerebral hemorrhage would seem to constitute a condition in which it would not be best to invoke the characteristic influences of the general application; here again, however, I know of no instance wherein the hypothesis has been put to the test of trial.

Atheroma and Irregular Pulse.—The belief entertained by many that patients with atheromatous arteries or irregular pulse should not be subjected to the body treatment, is a fallacy.

Clinical observation justifies the statement that atheromatous arteries are softened and rendered more functionable by the use of this measure, through absorption of lime salts deposited in their walls and, at least partial, regeneration of normal connective tissue elements; we have repeatedly treated individuals who have had previously one and two cerebral hemorrhages with none but beneficial results.

In treating patients exhibiting atheromatous phenomena it is well to run the heat up slowly during the first three or four séances, watching the effects carefully meanwhile and suspending further increase in treatment intensity when the heart and carotids begin to labor unduly; but we have never encountered the slightest cause for anxiety with them any more than with others when carefully handled.

Irregularity of the pulse coming on *during the treatment* of such a patient should always be a signal for the exercise of watchfulness and usually for the termination of the application.

Valvular Heart Lesions.—The modifications of the circulatory phenomena attributable to the general dry hot air application are so similar to those brought about by the administration of nitro-glycerine, sparteine, strychnia, etc., that the position involving objection to its employment with patients exhibiting valvular heart lesions becomes obviously untenable; this subject may therefore be dismissed without further consideration.

Pyrexia.—A glance at the list of diseases in the treatment of which this agent renders valuable service demonstrates that elevation of the body temperature interposes no valid objection to its administration. Fever, *per se,* is merely a secondary result of a primary pathological factor; its degree is dependent upon the intensity of the causative process and the degree of reactionary susceptibility exhibited by the individual patient, hence its treatment should be that of the condition producing it.

The phenomenon of pyrexia is believed by some observers to be directly dependent upon irritation of the sympathetic nerve centers by toxic bodies elaborated by the active primary pathological factors; by others as due to impairment of the heat inhibitory centers traceable to the same cause; and by still others it is believed to constitute an expression of nature's effort to rid herself of disability by accentuation of the normal metabolic (oxidative) processes, the increase in heat production being the logical physical result of accelerated chemical reactions, and energy transformation as represented by augmented reflex functionation of nervous structures.

If the last-mentioned explanation should ultimately prove to be the true one, and there is good reason for such belief, it is obvious that the remedial agent under discussion will be the most useful as well as the most logical means of combating secondary febrile phenomena now known; it is a pure and simple but powerful accelerant of normal physiological processes and being such merely assists in and augments the instinctive natural effort of the organism to regain its molecular, structural, and functional integrity.

Whatever explanation is accepted the palpable therapeutic indications suggested by modern conceptions of the direct etiology of fever, consist of measures tending to increase elimination of toxæmia and the functional vigor of the disturbed nerve centers; the general dry hot air application is extremely well calculated to accomplish both of these objects.

Another fact that may be significant in this connection, is that patients exhibiting febrile movement usually express themselves as being comforted and tranquilized by a dry hot air application; they welcome instead of resisting it.

At first thought it would be supposed that such an application would be intolerable to a patient who is already suffering from excessive elevation of temperature, but the actual result of the application tends to confirm the reasoning set forth in a preceding section as to the relative effects of heat and cold as regards the harmony or antagonism which they respectively exhibit, with reference to the natural efforts by which the organism endeavors to rid itself of disability. Future investi-

gation appears to promise interesting developments along the lines herein suggested.

Hyper-Pyrexia.—In this peculiar and interesting condition, wherein the general bodily metabolism seems to run amuck, dry hot air has not yet been tried as far as I know. The condition is supposed to be caused by exhaustion of the heat inhibitory centers brought about by an intolerable degree of irritation exercised upon them by toxic bodies in the blood.

The only remedy that has hitherto proven itself of much use has been the application of cold to the general surface of the body, which has been supposed to act by reflex stimulation of the exhausted nerve centers and by checking the excessive metabolic activity through the abstraction of heat.

As we have seen, when considering the physiological action of dry hot air, there is a vital difference between the effects of hot and cold applications and as a rule this difference favors the employment of heat rather than cold. Whether or not this is the case as regards hyper-pyrexia is a matter for future investigation to decide. As was also explained in the previous chapter dry hot air applications of appropriate intensity accomplish their stimulation without imposing any initial strain upon the vital powers; in the condition under consideration these powers are already strained beyond their limit of endurance and if the reinvigoration could be secured without the production of additional antagonistic tension it would seem to be desirable to so secure it.

Present knowledge and logic, therefore, would seem to indicate that investigation of the effects of dry hot air in hyperpyrexia would be justifiable as well as interesting.

Local Infective or Inflammatory Foci.—It is sometimes stated that dry hot air applications to localized inflammatory processes of any sort are dangerous and likely to transform the local into a general pathological condition. I have never heard a logical defense of this position, I have never heard of an authentic case wherein there was any satisfactory evidence that such a result was properly attributable to dry hot air, and in the hundreds of such treatments that I have administered myself and have had administered under my supervision

to such cases, I have never in a single instance, seen the slightest reason for believing that dry hot air was guilty or capable of precipitating such a disaster; I am therefore free to state my entire disbelief in the existence of any cause for apprehension in this respect.

Until experience has widened, however, it will be wise to exercise a judicious conservatism when invading pathological fields wherein the actual effects of this very potent agency have not yet been investigated, the capacity of a measure for the production of good being sometimes only equaled by its evil tendencies when applied to improperly selected conditions.

We will now consider the practical application of dry hot air to those diseases in the treatment of which it has been demonstrated to be of value, and the order in which these diseases are considered will be found to coincide approximately with the degree of importance which the agent assumes in their management.

CHAPTER IV.

SPRAINS.

Modifications of Clinical Conditions producible with Dry Hot Air.

Local Application.

First, immediate relief of pain, which relief can be rendered practically permanent by repeating the treatment as often as the pain becomes troublesome.

Second, rapid removal of exudate.

Third, a rapidity of repair which exceeds that attainable with any other agent now known, and by reason of which, general systemic impairment due to pain or lack of exercise from confinement to the bed, chair, or house never supervenes.

General Application.

Hastening of the reparative process in all cases, and rapid removal of general debility in old cases.

RATIONALE OF THERMOTHERAPY.

Pathology and Symptomatology.—A sprain consists simply, in uncomplicated cases, of traumatic solution of the continuity of soft issues about the affected joint, accompanied by severe pain and more or less impairment of function; a strictly local condition which is not inherently capable of precipitating secondary phenomena which threaten the integrity of the organism at large.

Therapeutic Indications.—First, to relieve the pain.

Second, to so influence the trophic functions of the affected part as to secure the quickest possible repair.

Third, to secure absorption of the exudate.

Local Application.—Theoretically the physiological influence of the local dry hot air treatment should be most ex-

quisitely applicable here; practically, clinical experience demonstrated the validity of the deduction. As a matter of fact if a sprain is gotten under treatment by this agent within four or five hours after the injury has been sustained, the pain will be relieved within half an hour and all traces of the trouble will frequently have disappeared within forty-eight hours. If the case has been running on for two or three days, on the other hand, and exudate is present to any great extent complete removal of disability will require from one to three weeks; the pain, however, is susceptible of the same immediate relief as in the early cases.

Although such results may appear magical at first thought, yet when the subject is considered from an analytical standpoint it is recognized that the agent produces its results in the same way as does every other successful treatment of the condition, viz., through its action upon the circulatory and trophic functions. The greater rapidity of repair obtained and the more effectual relief of pain, are due merely to the greater profundity of its physiological action, and its general influence in these directions is beautifully exemplified by its effects in this condition.

It is only necessary to compare the course of events marking recovery from a sprain under ordinary management, which not infrequently extends over a period of six or eight weeks, with those just outlined in order that the immense advantages exhibited by dry hot air in the treatment of the condition may be appreciated.

If a sprain is complicated by bony fracture the local application will usually relieve the pain somewhat; less frequently it will not relieve it at all; and sometimes it makes it worse. If the treatment fails to produce practically complete relief of pain it is almost positive evidence that such fracture coexists.

General Application.—A sprain is usually sustained while the victim is in good health, and as the lesion manifests no inherent tendencies toward impairment of the general metabolic functions the body treatment is rarely called for in recent cases. In those of some standing, however, wherein the central nervous system is feeling the evil influence of long-continued pain

and loss of sleep, in patients exhibiting a low grade of vitality, or when repair has become sluggish from any cause the general application is of the greatest assistance.

ILLUSTRATIVE CASE.

Mrs. R. H., aged sixty-three years. Patient had slipped on a curbstone during the afternoon of May 26, 1900, spraining her left ankle. I was asked to see her in the evening, at which time severe throbbing pain was constantly present, a swelling about the size of a butternut was evident just below and anterior to the external malleolus, and the tissues in this region were so sensitive as to be entirely intolerant of any but the gentlest of manipulation. She was unable to put her foot to the floor because of the resultant excruciating exacerbation of the pain.

A local dry hot air treatment was administered at 450° F. for an hour, which entirely relieved the pain, and she was put to bed without any bandage or other local application to the foot.

May 27th, 11 A. M. Patient had been free from pain during the night and had slept well. The swelling had diminished a good fifty per cent., and only deep pressure upon the injured tissues elicited protest. Stepping upon the affected member caused her slight pain and holding it suspended downward provoked a dull, throbbing ache.

Another local dry hot air treatment was administered at 485° F. for an hour, an elastic bandage applied about the ankle in such a way as to give support to the lacerated structures and the patient allowed to be up and about at her pleasure.

May 27th, 10 P. M. Ankle had been entirely comfortable all day. Swelling had entirely disappeared, but some tenderness upon deep pressure was still observable immediately below and anterior to the outer malleolus.

The third and last dry hot air application was administered and directions given to apply the elastic bandage again next morning before she left her bed.

I saw her again during the morning of May 29th, or sixty hours after the first dry hot air treatment had been given, and all signs of the injury had disappeared; the elastic bandage was discarded and the incident closed.

TREATMENT.

Local Dry Hot Air Application.—A sprained joint rapidly becomes extremely sensitive to manipulation and when one

comes under treatment, however early, the slightest movement will usually cause excruciating pain. The wrappings should therefore be applied with the utmost gentleness and when pressing them against parts that complain during administration this exquisite sensitiveness should be borne in mind.

The application should be continued for an hour and the degree of heat employed should not be less than 350° F.; in some cases it will need to be pushed to 450° F. If the joint is superficial, the patient not obese, and little œdema present 350° F. will usually be sufficient; if the impaired structures are covered by large muscles or a thick layer of adipose or œdematous tissue, on the other hand, from 400° to 450° F. will be required.

After the séance, if the patient desires to move about the joint should be enwrapped by an elastic stockinet bandage, so applied as to support the ligaments tension upon which causes pain. When sitting or lying down no bandage is necessary but the joint should be kept elevated; observance of this latter point will frequently prevent the pain from becoming troublesome after the first treatment.

In old cases relief of pain is just as prompt but repair is slower in proportion as exudation and secondary changes in the tissues are extensive.

The local application should be made twice daily anyway and oftener if return of pain demands it.

General Dry Hot Air Application.—The technique is that usual to this procedure; it may be applied every other day until three applications have been given and every third day thereafter if its continued use should be necessary.

Additional Remedial Measures.

When dry hot air is applied early any other measure will very rarely indeed require consideration at all, but in older cases other agents are useful in combination with it.

Mechanical vibratory stimulation, the electrical currents, massage, and alternating hot and cold douche, applied daily in alternation with the thermal agent, one in the morning, another at noon and another at night, are efficient in the order

in which they are named; the two first-mentioned when used alone sometimes will produce results that rival those obtainable with dry hot air.

Liniments are uncalled for, and useless except as lubricants, when dry hot air is available.

CHAPTER V.

RHEUMATISM.

Modifications of Clinical Conditions producible with Dry Hot Air.

Local Application.

First, immediate relief of the pain however severe, which relief may be rendered practically continuous by repeating the treatments as often as the pain becomes troublesome, every four hours if necessary.

Second, shortening of the duration of the disease, the same usually lasting only from five to ten days when dry hot air is thoroughly administered in combination with well chosen drugs.

Third, lessening of the likelihood of cardiac involvement, because the rapid control obtained over the condition diminishes the time period during which the infection threatens structures other than those originally involved.

Fourth, lessening of the number and quantity of medicines which it is necessary for the patient to ingest, because of the increase produced in the intensity and efficiency of their action at the seat of infection.

General Application.

Lessening of general systemic toxæmia and intensification of the physiological resistance of the organism as a whole.

RATIONALE OF THERMOTHERAPY.

Etiology, Pathology, and Symptomatology.—In the early seventies of the century just closed McLagon of London, England, published his belief that rheumatism was a disease caused by a specific " Materies morbi " circulating in the blood, and that salicylic acid as a specific curative agent sustained much the same relation to it that quinine was believed to sustain

to malaria; that as a disease it was in many ways and to a considerable degree analogous to malaria. Although the announcement was met by the same overwhelming skepticism and derision that has so strangely been heaped upon nearly every great discovery in the medical world since the dawn of history, yet the conviction of its truth, at least as far as the etiological element is concerned, has steadily gained ground until the profession to-day is almost ready to look upon the infectious origin of the ailment as an established fact.

Discussion of the etiological ramifications *per se* does not come within the scope of this work, and those who desire to pursue the matter further will find a masterly and convincing exposition of this view of the subject in the second volume of the "Twentieth Century Practice of Medicine," in the section devoted to this somewhat remarkable and most interesting disease. We are somewhat concerned, however, as will be seen later, with the latter part of the McLagon contention, viz.: that salicylic acid is as much of a "specific" in the treatment of rheumatism as is quinine in that of malaria.

The pathology present consists of fluid effusion into the subcutaneous tissues overlying the affected joint, the soft tissues immediately about the joint, and to a limited extent into the joint cavity; and an inflammatory process involving these structures which is intense in its nature and exhibits the well-known characteristic that, no matter what the degree of severity, it never eventuates in suppuration. After an attack of true, uncomplicated rheumatism has subsided the affected joint structures spontaneously and completely resume their normal condition.

Fibrous adhesions have commonly been looked upon as forming a prominent element in the pathology of "chronic" rheumatism, but modern clinical observation and knowledge indicate that this condition is rarely, if ever, met with as a post-rheumatic lesion and that when it is so alleged the diagnosis of the original trouble should be subjected to close scrutiny.

The joint pathology is accompanied by excruciating pain in the affected part, which is increased by motion and manipulation and probably due to pressure upon the nervous structures,

the presence of which, in turn, could easily be traceable to circulatory stasis in the part; and a condition of general systemic toxæmia evidenced by a moderate degree of febrile movement which is entirely irregular in its course, general malaise, and a profuse sour perspiration.

An undetermined etiology and a pathology so lacking in significant features, as far as indicating what direction treatment should assume is concerned, furnish us very unsatisfactory grounds upon which to build a rational therapy; we have therefore to depend principally upon the symptomatology and empirical knowledge for the evolution of a plan of management, and a study of the symptomatology would suggest directing our efforts toward the attainment of the following objects:

Therapeutic Indications.—First, relief of the pain, which symptom is probably due to circulatory stasis.

Second, removal of the local inflammatory conditions and restoration of joint function.

Third, reduction of the general systemic toxæmia.

Local Application.—The palliative influence of hot applications upon the pain of rheumatic inflammation has long been a matter of common knowledge and it was this fact that first led me to employ dry hot air in treating this affection; if mild degrees of heat would give some relief greater intensities might be productive of much benefit. The results which followed its use so far exceeded my expectations as to border upon the marvelous. Patients who were suffering indescribable torment were transported to a condition of ease and comfort in half an hour and would sometimes have recovered entirely in a few days; mechanics who had been unable to work for months and in whom the general condition had been much impaired by the disease were restored to health and enabled to resume their occupations in two weeks.

To one who is not in the habit of treating rheumatism with this agent the effects obtainable are absolutely beyond belief unless personally witnessed. Professor Wood of Philadelphia voiced a sentiment common to thermotherapists when he made the remark that the results of dry hot air applications to some joint conditions were "almost miraculous."

At the time of my original observations along this line I had not expended much thought upon the physiological action of the agent, but when we study this in connection with the causation of rheumatic pain we are no longer surprised at its efficiency in relieving the same; it is simply a manifestation of the powerful influence of the local dry hot air application in overcoming local circulatory stasis whereby pressure upon nervous structures is relieved. How much, or whether much of the effect is due to stimulation of local oxidation processes through the raising of the temperature of the part *en masse,* or to local elimination of toxins cannot at present be definitely stated; removal of circulatory stasis, however, would seem to be sufficient to account for the result without having to assume that any other factor is active.

That the influence upon the local conditions other than stasis is, however, profound is evidenced by the facts that great immediate improvement in the general condition, which goes on to rapid recovery, usually follows the administration of local dry hot air applications *if an appropriate salicyl compound is given in efficient dosage along with the thermal agent;* that such improvement is much greater and recovery much quicker than when the salicyl is administered without the dry hot air; and that a convalescence that is dragging along unsatisfactorily under salicyl treatment alone will be accelerated and rapidly eventuate in full recovery when the thermal element is added to the therapeutical regimen. The relief of local stasis and pain is not sufficient to account for these phenomena; they are explicable only upon the assumption that influence has been exerted, either directly or indirectly, upon one or more of the primary causative factors. What these factors are or in what way they respond to this influence cannot be stated until the etiology of the disease has been conclusively ascertained.

Conversely to the foregoing it may be as well to state here, as elsewhere, that dry hot air applications *without* salicylic acid do not constitute a satisfactory management for rheumatism in any large number of consecutive cases. It will almost always relieve the pain temporarily, but it cannot be depended upon to cure the disease.

The preceding paragraph would suggest the query "Why will not dry hot air alone cure rheumatism? If, as is all but proven, this ailment is of microbic etiology it resembles, to some extent, local septic infection, and it would naturally be expected that the agent ought to exercise much the same power over rheumatism that it does (as we shall see in the following chapter) over septic infection?"

We can only answer that the infective agent of rheumatism differs from other pathogenic germs. We have already noted one great and important peculiarity, viz.: that the inflammatory process of which it is provocative never eventuates in suppuration; if it differs in one particular it may safely be assumed to be capable of differing in others, and the extent and number of its variations cannot be estimated until it has been isolated and studied.

Whatever the future may divulge as to these points the fact which concerns us in this connection remains, viz., that the simultaneous administration of salicyl compounds is necessary to-day, in order that dry hot air may produce its most effective influence upon true rheumatic inflammation, and it will be helpful to consider briefly at this point the relation sustained by this drug to the problem under discussion.

Is Salicylic Acid a "Specific" for Rheumatism?—The claim that this substance is as much of a specific in the treatment of rheumatism as is quinine in that of malaria, is as bitterly opposed to-day by many as was the claim for an infectious causation of the former disease thirty years ago. In order to decide this point definitely it would first be necessary to understand the *modus operandi* by which the well-known influences of quinine upon malaria and of salicylic acid upon rheumatism are brought about.

It was formerly supposed that the curative effect of quinine upon malaria was due to a toxic influence exerted by this substance upon the plasmodium, either directly or by modification of its pabulum; the advocates of the McLagon contention considered it probable that salicylic acid acted in an analogous manner upon the specific *materies morbi* of rheumatism. Recent radiological studies by King, Busc, Halberstaedter,

Dreyer, and others, have, however, given rise to the conception that the curative power of quinine may be due to its property of modifying the fluorescence of the blood rather than to direct toxic action exerted upon the specific infective agent; salicylic acid is also a fluorescible substance, and the McLagon chain of analogy between malaria and rheumatism which first led its author to administer salicin for the cure of the last-mentioned disease may thus, perhaps, be ultimately furnished with another link.

As the facts stand at present we cannot arrive at a positive solution of the problem, but the future seems pregnant with interesting developments along these lines. We are living in an age of rapid progress; an age that has been characterized by the demolition of theories that for years had been looked upon as impregnably intrenched behind the rampart of truth, and he is a bold man who to-day will say to the enterprising theorist, as Canute said to the sea, "Thus far shalt thou go and no farther." As far as the present discussion is concerned, however, the most important fact upon which the claim for specificness of the salicyl compounds has been assailed is, that they fail to cure in many cases, and some significant information bearing upon this point may be gathered by noting some of the clinical aspects of these diseases as regards response to their alleged specific remedies.

The belief that quinine bears such a relation to malaria was engendered by the repeated observations of a large number of physicians, which demonstrated that the disease almost invariably responded happily to administration of the drug in adequate dosage; many clinicians indeed hold that if a given case does not so respond the diagnosis of malaria must be changed, however well justified in the first place.

Now although this belief is so thoroughly established in the medical mind to-day, and it has stood the test of practical experience for many years, yet occasionally a victim of malaria is encountered who is taking quinine to the point of intoxication and shaking at each regular interval in spite of it. This does not invalidate the claims of the drug to specificness in our minds, however, because we know that the cause of its

failure is inefficiency of assimilation or metabolism somewhere in the economy, and that when this has been corrected the drug will manifest its customary influence; the difficulty is not that the remedy has proven itself inherently incapable, but that it has been called upon to exhibit its powers under overwhelming inhibitive conditions. If the interfering factor is the liver, a chologogue is administered; if general debility, strychnia and iron, or arsenic; *then* quinine, and the malaria disappears.

Another prominent factor tending toward maintenance of the reputation of quinine as a specific for malaria is the fact that remedies which have long been known and commonly used as tonics constitute efficient auxiliary agents for the removal of conditions which interfere with the exercise of its characteristic influence. Still another fact that has been favorable to quinine in this connection is that many trivial conditions which would respond to mild tonic and chologogue remedies have in the past been erroneously diagnosticated as "Malaria," hence the drug has absorbed considerably more credit than rightfully belonged to it.

As regards salicylic acid, the conditions have been very different. In the first place comparatively few practitioners have given the drug in sufficiently large quantities; one or two grams of sodium salicylate per day having been called upon to cure when two or three times that quantity should have been given, and inefficiency has, of course, resulted.

Second, many stomachs, hearts, and kidneys cannot tolerate sodium salicylate in sufficient dosage to effect the desired result, and although the substitution of salicin will usually overcome this difficulty, it requires to be given in twice as large a quantity (4 to 8 grams per day) as sodium salicylate in order that the same degree of salicyl influence may be secured, and the disadvantage contingent upon this greater bulk has generally resulted in the more irritant substance being employed.

Third, although the undeniable inefficiency of salicylic acid in some of those cases wherein adequate dosage was practicable and *practiced* would naturally first suggest, to follow out the malarial analogy, that impairment of assimilation and metab-

olism, local or general, was the element of interference, yet the drugs ordinarily used to remove such impairment have not proven nearly as uniformly successful as auxiliaries to the salicyl compounds in the attack upon rheumatism, as to quinine in that upon malaria; the logical inference being that the incapacity of salicylic acid so manifested was inherent in itself.

Fourth, many conditions exhibiting painful joints, nerves, or muscles as symptomatic phenomena, have in the past been diagnosticated as rheumatism which were not rheumatism at all, and no matter how specific the drug might be against rheumatism it would not of course be expected to acquire any lasting laurels under such circumstances.

Lastly, there are very few other painful conditions that would be likely to be confounded with rheumatism and which would respond happily to anti-rheumatic treatment, hence the drug would not be accredited with curative results for which it was not responsible.

It becomes apparent at once then that the opponents of the McLagon contention as to the specificness of salicylic acid in rheumatism have had good evidence upon which to base their position, and as much of this evidence is the result of practical experience it is the most difficult sort to disprove. The evolution of salicyl compounds which are not intolerable to the stomach, heart, and kidneys, whereby adequate dosage has been rendered possible, is doing away with much of it; increase in diagnostic knowledge and ability is doing away with a great deal; and it would seem probable that the advent of dry hot air as an efficient auxiliary measure for the improvement of local and general metabolism and assimilation might remove the rest.

Be that as it may, the fact is readily demonstrable to-day that the extinction of almost any attack of true rheumatism, however severe, can be as satisfactorily and positively accomplished by the proper administration of salicylic acid supported by dry hot air treatments as can an attack of any other disease by its appropriate specific drug management, not excepting malaria. That the thermal agent is only entitled to credit as an *auxiliary*

measure through which to remove conditions that interfere with the exercise of the characteristic salicyl influence, is proven by the fact that few cases respond satisfactorily to dry hot air when this agent is used alone.

The results of the employment of dry hot air in the management of rheumatism then may possibly forge still another link for McLagon's chain of analogy and constitute another bit of confirmatory evidence as regards his contention that salicylic acid is a specific remedy in the treatment of this disease.

General Application.—The physiological action of this measure at once suggests its employment with patients who have become debilitated by a protracted attack of the disease, or when systemic toxæmia is pronounced; the validity of the inference is confirmable by practical experience.

DIAGNOSIS.

The correct diagnosis of a condition presenting clinical phenomena of an apparently rheumatic nature is a matter of the first importance, and as anti-rheumatic treatment is not only futile but occasionally positively injurious, in some conditions closely resembling this disease, the diagnosis should be made before treatment is instituted. The amount of undeserved opprobrium that rheumatism has been made to bear may be inferred from the fact that probably three-fourths of the cases that were diagnosticated as rheumatism previously to three years ago, were not rheumatism at all, and further, involved the practical point of being disease processes that would not respond happily to anti-rheumatic therapeusis.

The more important conditions from which it is to be differentiated are as follow: arthritis deformans; neuritis; neuralgias; myalgias; osteomyelitis; tubercular, syphilitic, gonorrheal, and traumatic osteitis and periosteitis; and non-rheumatic synovitis and myositis, which last is of rare occurrence, but sometimes offers a diagnostic problem which may be puzzling in the highest degree for a short time. Pressure from tumors, especially those occurring in the retroperitoneal lymphatics and which involve the nerve trunks and plexuses in these vicinities, orthopedic deformities—especially flat foot,—

and the occupation neuroses in their earlier stages, deserve a much greater amount of consideration in this connection than is generally accorded to them.

The two first- and two last-mentioned conditions are concerned in by far the greater number of diagnostic errors, and in these also early recognition is of great importance. The diagnosis of true inflammatory rheumatism is so well set forth in the ordinary text-books and the clinical picture is so familiar that further consideration in this volume is uncalled for.

ILLUSTRATIVE CASES.

Acute Rheumatism.—I was consulted by Mr. G. L. M., forty-five years old, February 28, 1899. He had had inflammatory rheumatism two or three times before, the last attack preceding this one having occurred in 1891, at which time he was ill for three months, both ankles and the right great toe joint being involved. His father had suffered frequently and severely with inflammatory rheumatism (?) and his mother had been gouty (?). When I was called he had been suffering for two weeks, the left hip being the part involved, and during this time he informed me that he had been taking salophen and alkalithia constantly, with no result. The symptoms had increased rapidly in intensity during the preceding two days, and he had had no sleep for twenty-four hours and very little for forty-eight hours. Joint was extremely sensitive to manipulation and pressure. Dry hot air was applied locally and the pain was entirely gone in twenty minutes. At the conclusion of the treatment the joint could be manipulated within certain limits without any pain. I requested the patient to call at my office the following morning if he was able. Salophen was prescribed internally, one gram three times a day.

He appeared at the time appointed, March 1st, reporting that he had experienced no pain after the treatment of the preceding day until this morning on arising from bed, but that since then it had been slightly, but constantly present. He was on his way to business and had "only dropped in to let me know that he was all right." I persuaded him to allow me to treat him again, but he would not relinquish his intention of attending to his business. I treated him for an hour, with entire relief of pain as before, and he promised to report the next day.

March 2d. Patient called this morning, informing me that half an hour after leaving my office yesterday he had suffered from an acute attack of pain, lasting about ten minutes, which

had then subsided, and he had felt it no more until this morning, when, for half an hour, it was quite severe. Another remonstrance as to his continuing to perform his business duties was met by the assertion that to stop at this time would entail financial loss that he was unwilling to sustain, and that as long as he continued as comfortable and as free from pain as he was then he would rather keep about his business and take a longer time for his recovery. He was treated and requested to report the next day.

March 3d. No pain since last treatment, but feels a dull soreness in parts, which is growing steadily less. Dry hot air was again administered. Patient desired to stop his salophen, but it is unnecessary to say was ordered to continue. He did not call again until March 8th, when he reported having had slight twinges of pain always in the morning on arising and occasionally during the day, but of steadily decreasing severity since the last treatment. This morning for the first time since the attack began, he had been entirely free from pain of any sort. He laughingly derided me for having desired to keep him in bed and said, as I supposed in joke, that he wasn't "going to take any more of those powders."

March 11th. Patient had continued to feel so well after his last call that he had carried out his threat of stopping the salophen, and yesterday he began to suffer again. Resumed salophen, and toward evening grew more comfortable, but this morning pain is again quite severe. Dry hot air gave its customary immediate relief, but patient was going out of town and could not call again for treatment until two days after.

March 13th. Reports freedom from pain all day on the 11th, but it was present considerably yesterday and this morning. Dry hot air administered with the usual happy result.

March 14th. Slipped on a curbstone while running to catch a car yesterday, wrenching the affected hip badly. Suffered from excruciating pain for an hour, which then subsided, leaving intense soreness and throbbing which were present this morning. Treated with dry hot air, but pain, for the first and only time, was not entirely relieved, and the patient left my operating room with a slight limp.

March 15th. He appeared at my office at 7.30 A. M., reporting that pain returned quite severely four hours after treatment, and had stayed with him pretty sharply ever since. Insisted that he could not leave his business and remain quietly at home, and I suggested that he be treated three times that day,

to which he consented. I treated him at 9 A. M., at 2 P. M. and 7 P. M., with the result that he kept about his business and had practically no pain.

March 16th. Came to my office at 9 A. M., reporting that he had had no pain until eight o'clock after rising from bed, and then only slight dull twinges. Administered dry hot air at 9 A. M. with the usual satisfactory result, and requested him to call again for treatment at two in the afternoon. He did so, informing me that he had had no pain at all since morning, and expressed himself as feeling better generally and locally than at any time since the attack began. Ordered him to come in the evening if he felt the slightest return of the pain. I did not see him again for a week.

On March 23d he came to my office early in the afternoon, supporting his right arm with his left, suffering with intense pain in his right shoulder, which he said had commenced about 11 A. M. The slightest movement of the affected joint forced him to cry out, and when I had succeeded, with great difficulty and the utmost care and gentleness, in removing his clothing preparatory to treatment, he was shaking like a leaf. I applied dry hot air with the usual result; pain was relieved in ten minutes. At the end of the treatment he could move his arm sufficiently to get into his clothing without assistance, was perfectly free from pain, but could not raise his elbow to within more than three inches of the level of his shoulder. He had had no trouble with the hip since the last treatment, and I will say here that the recovery of this joint was complete and remained so. I directed him to call again for treatment in the evening. At that time he was suffering slightly, but was able to remove his clothing for treatment without assistance. Dry hot air was administered and directions given to call again next morning if he was in any pain at that time. I did not see him again until March 25th, when he called to tell me that he had had some slight twinges of pain during the night following the last treatment, but had remained free from it ever since. I requested him to call immediately if any more symptoms appeared, and to continue the salophen for two weeks. Five days afterward, on March 30th, he called, complaining of a dull aching in the right shoulder which I dissipated with one treatment, and that was the last of the trouble.

I quote this particular case, not because of the rapidity with which a cure was obtained, but because it is very instructive in this connection when the different phases which it exhibited are studied carefully.

First, it was treated exclusively, as far as dry hot air was concerned, with the local application.

Second, it illustrates forcibly the power of dry hot air to rapidly alleviate rheumatic pain.

Third, it exemplifies the necessity of accompanying dry hot air applications with appropriate internal medication, as shown by the severe return of symptoms in the same old place on March 10th and 11th, after the salophen had been prematurely discontinued.

Fourth, when I state that the total length of time during which this patient was under treatment, viz., one month, is longer than that required for the recovery of any other case of rheumatism, however severe, that I have ever submitted to this management, and when we compare this period with that usually required for recovery from an ordinarily severe rheumatic attack under other methods of treatment, it exemplifies in a very gratifying manner the power of dry hot air to shorten the duration and lessen the symptomatic intensity of the disease.

Here was a severe case in active eruption in a patient exhibiting a strongly rheumatic tendency; he kept up and about his business all the time, and yet, in spite of this utter and constant disregard of one of the prime essentials to be secured in the treatment of inflamed joints, viz.: rest, the attack was extinguished completely in a month. Not only this, but the patient had been kept entirely free from pain the vastly greater part of the time during that month; an achievement which could not be claimed as among the possibilities for any other treatment with which I am acquainted, however perfect might be the rest secured. When the patient can be kept at rest it has uniformly been my experience that an attack of acute rheumatism is extinguished in from five to ten days, whatever the degree of severity exhibited when it comes under treatment, and I have had cases of moderate severity recover with but three applications.

Chronic Rheumatism.—Mr. J. D., brass worker, 33 years old, was referred to us for treatment by Dr. James Stretch,

of Stafford Springs, Conn., and was admitted to the sanitarium November 11, 1903. He had been ill with rheumatism for the preceding ten months, which had involved nearly all of the large joints in his body at different times. When he was admitted the disease was manifesting itself by pain and soreness upon movement in both shoulders, the left being the worse, the right knee and the left ankle, the knee and ankle being some swollen. He was much debilitated.

He was put upon aspirin, one gram four times daily, and during the next nine days was given five body dry hot air treatments, four applications of the mechanical vibrator to his posterior spinal nerve roots, five general tonic applications of static electricity, one spinal galvanization, and two applications of the negative pole of the galvanic current slowly interrupted, to his left shoulder.

During the last three of these nine days he had been entirely free from pain and joint disability and felt so much better generally that he decided to return to work, against my advice it is unnecessary to state. Four days after his return to work he sustained a sharp return of the trouble in both shoulders. This yielded to aspirin completely in two days, however, and he heard no more of it.

This case is particularly instructive because the patient came under our care directly from a large public hospital where he had had several weeks of the best ordinary anti-rheumatic management without positive result. The addition of dry hot air and the other physical measures to the therapeutical regimen, however, produced the above marked and very satisfactory result in nine days.

TREATMENT.

Five years ago in an article concerning dry hot air, the writer expressed the opinion that a "new leaf" was about to be turned in the history of the clinical results of rheumatic therapeusis, and subsequent experience has justified the inference then noted. It is in this disease that the agent has won some of its most enduring laurels. Its mode of application and the results derivable therefrom are now well defined, and the treatment of the disorder has reached a point where it can no longer be regarded as a reproach to the profession.

Clinical Forms of Rheumatism.—It is necessary to divide

rheumatic cases into but two classes for therapeutic purposes, acute and chronic.

If the acute stage is properly and thoroughly managed there will very rarely indeed be any chronic stage to consider, but this could not have been affirmed before the therapeutical advent of dry hot air. The cause of chronicity has resided mostly in impairment of local and general metabolism, through the influence of long-continued pain and the long-continued presence of rheumatic toxins in the blood and tissues of the affected regions, by reason of which it became impossible for the remedies ingested to be assimilated effectively by such tissues. Dry hot air, through its power of relieving stasis and stimulating sluggish metabolism, renders rapid and effective the assimilation of the appropriate remedies, the general nervous system is not therefore subjected to drug pain or unendurable toxin depression and recovery is rapid and satisfactory.

It is probably not practicable to drop the term "chronic" rheumatism entirely at present because inefficient medication or conditions of general debility present when the infection was contracted, or which supervene because of a protracted attack, will combine to cause chronicity; as previously suggested, however, great care should be exercised in making a diagnosis of chronic rheumatism.

Complications.—It is hardly necessary to state that any other pathological conditions which may exist when an attack of rheumatism is sustained should receive attention. Sometimes the system is so depressed by such a complication that the rheumatism cannot be removed until such complication has been attended to. We once had a patient under treatment for rheumatic polyarthritis for three weeks and were able to secure only temporary relief. At last it was discovered that she had a tapeworm, a fact of which she had previously had no suspicion. After the removal of an eighteen-foot parasite her recovery was immediate and perfect.

Local Dry Hot Air Application.—The local treatment is usually the only thermo-therapeutical modality which it is necessary to employ in the treatment of true rheumatism. If

more than one joint are affected as many as possible of them should be treated at once with as many separate apparatuses. It should be applied at least twice a day at a temperature of from 350° to 400° F. for an hour until the soreness and pain in the parts have entirely disappeared. When the pain returns after the treatment the same may be applied again immediately. Usually fifteen or twenty minutes will entirely remove the pain from the most violent cases, and it remains quiescent for a variable period, ordinarily from four to six hours. By repeating the application whenever the pain returns the patient can be kept practically free from marked discomfort during the whole of his convalescence, the inauguration of which usually coincides with his first dry hot air treatment.

After-Care.—Suppression of the functions of affected joints after the thermal application is always helpful, but not always absolutely necessary. Massage and passive movement are always unnecessary and sometimes interfere markedly with the patient's comfort, either immediately or shortly afterwards. The limb may be done up in absorbent cotton or flannel, but liniments or other external applications are usually uncalled for and useless.

General Dry Hot Air Application.—The body dry hot air treatment is always useful and occasionally necessary for removing metabolic impairment from systemic toxæmia and debility, but for the routine treatment of the disease it is not essential.

An important advantage contingent upon the employment of dry hot air applications in rheumatism is that as local metabolism is thereby kept at its point of greatest activity, assimilation of medicines by the tissues of the infected regions is rapid and complete; *less* of the drug is therefore required to be introduced into the general circulation and less systemic disturbance ensues therefrom. As a matter of fact, when dry hot air is administered in conjunction with the proper salicyl compound systemic disturbance of any sort or degree is of extremely rare occurrence.

Additional Remedial Measures.

Diet.—Rigid restriction of the diet within narrow limits in this disease is not of nearly as much importance as is ordinarily supposed. Its regulation should be governed by the manifest needs of the patient's economy and the effects of the unaccustomed conditions surrounding him as regards lack of exercise, etc., rather than by the mere fact that he has *rheumatism.* The disease has in the past been so inextricably entangled with lithæmic and gouty conditions that the diet has been made to assume an unduly specific character. The patient should be fed as would a person sick with any other disease which had impaired his power of digestion and assimilation, and whose muscular and nervous systems were weakened by toxæmia and sluggish from lack of exercise. If his digestive powers are equal to beefsteak it may be given him without fear.

Plenty of liquid—in the form of milk (one quart per day) or water (carbonated, plain, or in lemonade) is essential for the patient's best good.

Drugs.

From what has been said in previous sections it will be seen that salicylic acid in some form should always constitute one of the principal elements of anti-rheumatic therapy. Because of its irritative tendencies toward the stomach and kidneys and its depressing influence upon the heart, however, it sometimes so impairs digestion, assimilation, and metabolism either general or local, or both, that it destroys its own effectiveness by rendering impossible its ingestion in sufficient quantity; hence the selection of the particular form in which it is to be administered is important. Those most worthy of consideration are aspirin, salicin, sodium salicylate, salophen, and methyl salicylate, and their desirability according to our experience is in the order in which they are named.

Aspirin.—This drug in doses of 3 or 4 grams per day is usually a perfectly effective anti-rheumatic and very rarely indeed produces any irritation of the stomach or kidneys or depression of the heart. Occasionally slight tinnitus or heart-

burn follows its use, and rarely a patient is encountered who cannot take it at all.

Salicin.—The bitter principle of willow bark is nearly as effective, but must be given in much larger quantities (4 to 10 grams daily), and the bulk is objectionable. Salicin has the advantage over all the others of being an excellent stomachic, and constitutes a most useful succedaneum to sodium salicylate when the latter drug has impaired digestion; it serves admirably to remove the gastric debility as well as to keep up the salicyl saturation of the blood.

Sodium Salicylate.—The gastric and renal consequences of administering this substance in full doses need only to be mentioned in order to be appreciated, but in cases where it is tolerated no drug performs better service.

Salophen.—A very useful drug which may be safely given in gram doses three times daily and does good analgetic work for a day or two, but in order to get a marked and sustained curative action larger quantities are usually required and then the heart is apt to suffer. It is, however, extremely valuable in some cases, and I shall refer to it again in connection with sciatica.

Methyl Salicylate.—This preparation is sometimes given by the mouth, but our experience has been that its use should preferably be restricted to external application after dry hot air treatments with those patients who cannot take any of the others in sufficient doses *per os.* Three or four thicknesses of gauze are laid smoothly over the joint affected, 5 or 10 grams of methyl salicylate soaked into it, and gutta-percha tissue wrapped around the whole and retained in place by a roller bandage. It enters the circulation by absorption through the skin.

Alkalies.—The practice of administering alkalies in this affection with or without a salicyl compound is a common one, but modern conceptions of the pathology of the disease do not furnish a logical indication for it, and although it does no harm, I have never been able to convince myself that it did any good, and have abandoned it

It will not frequently be found necessary to go beyond

aspirin. This drug is not miscible with water, but by thoroughly incorporating it with an equal quantity of powdered sugar it may be suspended in the liquid, and is best given in this manner, or in konseals.

In chronic cases, where pain is not a factor demanding immediate attention, it is well to precede the first dry hot air treatment by two or three doses of the salicyl selected. We thus secure a preparatory saturation of the patient's system and the case seems to progress more rapidly thereafter. In acute cases, however, immediate relief of the constant harassing pain is imperative, and the thermal application should be employed at once.

Salines.—As in every other general infection, the bowels must be kept freely open, and salines are the best agents to employ for this purpose.

Electricity.

The electrical currents usually play but a secondary part in the treatment of rheumatism when dry hot air is available. When dry hot air is not at hand, however, and sometimes in combination with dry hot air they are extremely useful and may be applied as follows:

The Static Current.—The spray over the spine for its general tonic effect, and the brush discharge for from thirty to forty minutes over the seat of the inflammatory process for sedation, relief of swelling, and improvement of metabolism. Sometimes the Morton wave current is extremely helpful in this situation.

The Magnetic-Induced Current.—Rapidly interrupted current from long, fine-wire coil passed directly through the tissues affected, for sedation and improvement of metabolism.

The Voltaic Current.—The positive pole over the affected tissues in acute cases, current uninterrupted will frequently give temporary relief from the pain and should be tried first, but sometimes the polarities must be reversed to obtain this result. We can tell which only by trying. Occasionally a case is encountered wherein a muscle remains sore upon movement after the attack has apparently entirely ended, and here a few

applications of the negative pole of the slowly interrupted galvanic current to the complaining structure will usually dissipate the trouble. In addition to its sedative action the galvanic current exercises a curative influence upon the disease through its power of stimulating tissue metabolism. Its action in this direction is probably identical with that of dry hot air, but much less powerful. When the part affected is a hand, foot, wrist, or ankle, the use of a hot-water bath electrode in which the member can be immersed is much more effective. From 5 to 15 milliamperes may be used for from ten to fifteen minutes.

Franklinism is the most useful of the electric modalities in rheumatism.

CHRONIC RHEUMATISM.

This term is used less and less frequently as our diagnostic knowledge and ability increase.

Treatment.—The management differs in no essential particular from that of the acute form except that as a considerable degree of general debility is nearly always present, the body treatment assumes a position of some importance in its management. It may be administered two or three times a week.

Because of this general debility other tonic measures such as static sparks, the wave current, galvanism, mechanical vibratory stimulation, etc., are most helpful. When dry hot air is not available these agents will render good service.

The drug treatment differs in only one particular from that of the acute form, viz.: the addition of general tonics to the salicyl regimen.

CHAPTER VI.

LOCAL SEPTIC INFECTION.

Modifications of Clinical Conditions producible with Dry Hot Air.

Local Application.

First, rapid relief of pain if applied before suppuration has become established, and partial relief if this event has already supervened. If confined pus is present the pain is sometimes increased.

Second, abrupt arrest of the tendency of the disease to progressively involve structure after structure, and sharp localization of the process and products of inflammation.

General Application.

First, a marked stimulation of the vital functions indicated by improvement in the circulatory phenomena before the patient leaves the apparatus, which is not followed by any pernicious reaction.

Second, rapid relief of the nerve centers from a large degree of toxin depression, because of the increase effected in the process of elimination.

Third, abrupt arrest of the tendency of the process to involve other structures, because of the augmented physiological resistance of the threatened tissues due to the vital stimulation and elimination effected.

Fourth, avoidance of evil reaction from drug stimulation, because an amount of depression sufficient to demand the employment of such remedies does not ordinarily obtain after the administration of body treatments has been commenced.

One of the most dreaded of the pathological states encountered with a moderate degree of frequency to-day is septic infection. In spite of the most careful observance of the

elaborate aseptic and antiseptic technique which has been developed from the never-to-be-forgotten work of Sir Joseph Lister, pathogenic micro-organisms will sometimes gain a lodgment in operation wounds, bringing in their train the usual accompaniment of harassing anxiety, protracted illness, suffering, and sometimes death; cuts and crushing injuries are frequently infected at the time they are sustained, or neglected then and infected later. Prevention is, of course, the best treatment, but in many cases prevention fails and in others it is impossible of attainment, so that some effective agent for combating established septic infection will always be in demand. Dry hot air satisfies this demand in a gratifying manner.

RATIONALE OF THERMOTHERAPY.

Etiology and Pathology.—In order to comprehend fully the logic of the application of the agent to this disease let us glance for a moment at the pathological conditions obtaining and which it is the aim of treatment to overcome.

The primary etiological factor consists of the lodgment in the lymph spaces of pathogenic micro-organisms. After this event has occurred, one of two things will happen:

First, what we will denominate the patient's constitutional resistive power, may be intense enough to enable the cells composing the invaded tissue to destroy the infective organisms, in which case nothing further will be heard from them.

Second, the patient's normal constitutional vitality may be lowered from some cause, or the resisting power of the tissues attacked may be weakened, as by impairment of the trophic nervous control from injury or shock, for instance, in which contingency the invading organisms find a pabulum suitable for their development. Once established they multiply with exceeding rapidity, spreading colony after colony into the numerous ramifications of the lymphatic system, until finally millions of bacteria are vomiting toxins upon the contiguous tissue cells, paralyzing their vitality and rendering larger and larger areas of tissue a favorable soil for further germ propagation. These toxines, together with the ptomaines resulting

from abnormal tissue metamorphosis, are taken up by the general blood circulation and brought into contact with all the nerve centers and other tissues of the body, exercising thereupon a most viciously depressing influence, whence results the evil clinical picture so harassingly familiar to most of us as "blood poisoning."

Two important points to be borne in mind in this connection are, first, that when the normal resisting power of the tissues is unimpaired it is probable that they are capable of resisting any ordinary microbic invasion; second, that most of the common pathogenic germs require for their propagation that the conditions most favorable to their development as regards the temperature of their environment, etc., be maintained with a moderate degree of uniformity.

Therapeutic Indications.—The objects of treatment as deduced from the above, then, would be as follow:

First, so to modify the environment of the colonies of microorganisms as to accomplish their destruction, inhibit their development, or lessen the virulence of their toxic emanations.

Second, to increase the physiological resistance of the infected organism as a whole, and of the cells composing its tissues as individuals.

Third, to eliminate as rapidly and profusely as possible the toxins already in the circulation.

The local and general applications have their distinct spheres of action in this disease, and it will assist in the elucidation of the problem before us if we consider them separately, bearing in mind their physiological actions as described in Chapter II.

Local Application.—When a local dry hot air application is made to one of the extremities of the body exhibiting the evidences of septic infection, the following sequence of events is inaugurated thereby.

First, the reflex stimulation of the vasomotor tracts through thermic irritation of the nerve endings in the skin relieves the fluid stasis in the part, thereby lessening the pain.

Second, the nutrition and cell vitality of the part are aug-

mented by reflex stimulation of the trophic nerve supply through the same influence.

Third, the raising of the temperature of the part *en masse* disturbs one of the most important conditions, which it is essential should be maintained unimpaired if the propagation of the micro-organisms is to reach its fullest development.

Fourth, the integumental emunctories are stimulated to greatly increased functionation.

Resulting from this we find that, first, the lessening of the pain quiets the patient's nervous system in direct proportion as the relief is complete, thereby conserving his nervous energy, and the relief of stasis insures a plentiful supply of raw material in the form of an augmented blood circulation, out of which new cells may be built up to take the place of the debilitated, toxin-impaired elements.

Second, the augmented trophic impulses result in advantage being taken of this increased supply of raw material for the rapid formation of cells possessing a heightened vitality, whereby the resisting power of the tissue is at once greatly increased.

Third, the raising of the temperature of the part *en masse* probably exercises an inhibitory influence upon the development of the colonies of micro-organisms, whereby the virulence and quantity of the toxins emanating therefrom are reduced in direct proportion as the inhibition is profound.

Fourth, the enormously increased functionation of the sweat glands removes directly from the parts most profoundly influenced by the intoxication, a certain proportion of the noxious substances which had previously been devitalizing fresh areas of tissue and passing into the general circulation.

As a consequence, instead of the destructive process spreading farther and farther into the sound tissues, we find that the cells at the periphery of the infection, which were just beginning to feel the debilitating influences of the approaching destruction, are regenerated and carry on their metabolic and reconstructive functions with a normal, or perhaps even an increased, degree of activity, pushing the lines of healthy tissues farther and farther into the diseased areas, until

finally the pathological mass is entirely replaced by healthy tissue and the patient has recovered, frequently without even a slough.

When a collection of pus is present before treatment is begun, however, it is necessary that it be evacuated, neither dry hot air or any other measure with which I am acquainted being capable of producing absorption. When pus is so present this agent exhibits another valuable attribute, viz., the power to localize the inflammatory process very closely to the abscess cavity when a stroke of the knife will end the trouble at once and forever.

General Application.—When the lymphatics of the joint connecting the invaded limb with the trunk have become infected, or when severe general toxæmia is present, the physiological effect of the local treatment will not usually be sufficient to produce a cure, because in these cases foci of infection are located in parts so situated that the maximum influence of the local treatment cannot be brought to bear directly upon them. Under these conditions it becomes necessary to call up all of our patient's reserve forces, to stir his vital resistance against the invading organisms to its profoundest depths, and the general application is indicated.

With this measure we cannot invoke the directly inhibitive influence upon germ development due to the raising of the temperature of the part that is obtainable with the local treatment, because the mouth temperature is rarely increased by the body treatment beyond 3° F. above the normal, and this is not enough to appreciably retard the growth of the streptococcus; indeed, patients very frequently exhibit elevation of temperature to this extent and more when they enter the apparatus. The greater beneficial power of the body treatment consists in, first, the greater proportion of systemic toxæmia which is eliminated through the resultant increased functionation of the skin, kidneys, and lungs, whereby the vital processes are more efficiently relieved of impairment and depression; and, second, its gratifying influence in stimulating to renewed vigor of function the deep spinal and sympathetic nerve centers that control tissue reconstruction and general metabolism, and which

have been overwhelmed to a greater or less extent by toxin accumulation in the general circulation. By its use is secured an increased activity in the resistance to further invasion on the part of the threatened tissues, and at the same time a more rapid elimination of the noxious products of such invasion as has already taken place.

The hyperleucocytosis which results from the body dry hot air application has been looked upon as an important element in the production of its beneficent effects in this disease. Whether this phenomenon, *per se,* has anything to do with the case, however, cannot be determined until the exact rôle of hyperleucocytosis in infectious processes is ascertained, and that is a matter for the future to decide.

It has been stated that local dry hot air applications will *always* increase the pain attending a localized septic process *if pus is present,* and that it is, therefore, of value as a diagnostic test for detecting the presence of suppuration. The writer has repeatedly seen the pain attending localized pus collections markedly *relieved* by local dry hot air applications, and has, therefore, no hesitation in expressing his absolute lack of confidence in this measure as a differential diagnostic test.

ILLUSTRATIVE CASES.

With regard to their treatment by this agent, cases of septic infection may be conveniently divided into three classes, as follow:

First, those in which the infection has taken place in a limb, and has not yet invaded the lymphatics of the joint connecting the member with the trunk, and which are nearly always early cases.

Second, those in which the lymphatics of the joint connecting the infected limb with the trunk have also become involved, but where the original focus of infection or other tissues have not yet become so profoundly affected as to demand surgical removal.

Third, those in which the lymphatics of the trunk are involved and tissues or glands are so hopelessly diseased as to demand immediate operative ablation.

The following reports have been selected with a view to illustrating these types; Case I exemplifies the first class.

Case I.

The writer's first experience with dry hot air in the treatment of well-marked septic infection, was on September 11, 1900. A patient was admitted to the sanitarium on that date who had developed a septic process from a cut on the little finger of her left hand two days previously. She had suffered intense pain for thirty-six hours, temperature had reached 103.5° F., pulse 112, and marked prostration was present. The hand and wrist had become involved, and red streaks followed the lymphatics up the arm nearly to the elbow. A local dry hot air treatment was administered in the hope of relieving pain, which it accomplished in forty-five minutes, and the patient slept for the first time in twenty-four hours. That evening, to my intense surprise and gratification, the patient's temperature had dropped to 99.2° F., the pulse to 60, and the pain had not returned to any great degree.

By the next morning the swelling and redness had nearly disappeared, but the temperature had risen again to 101.4° F., the pulse to 84, and the pain was considerable again. She was given a body dry hot air treatment. The pain in the affected hand and arm was relieved during this procedure, and did not return again sufficiently to demand another local treatment, and, to make a long story short, the affected members progressed to a complete and fairly steady recovery during the next four days, at which time the temperature reached the normal point and stayed there.

The next two cases were reported by me in the *Medical News*, issue of July 11, 1903, and illustrate the second and third types of infection, respectively.

Case II.

Mr. G. P. H., thirty-two years old, was brought to the sanitarium March 2, 1901, by Dr. A. S. Cheney, of New Haven. Four days previously he had cut his hand with a dirty jackknife. The usual evidences of infection duly appeared, and when he entered he was in a condition of profound prostration, with a temperature of 103.4° F., respiration 28, but the pulse was only 86. Hand and arm were considerably swollen. Lymphatic glands about the elbow and in the axilla were irregularly enlarged, those in the latter situation to about the size apparently of an English walnut. He was in constant, severe pain. The presence of deeply-located suppuration seemed probable,

but was not positively demonstrable. He had been brought in with the intention of operating the next day. It was finally decided, however, to treat him with dry hot air first, holding operative interference in reserve.

At noon of the day following his admission he was given a body dry hot air treatment at 340° F. Perspiration was profuse, the pain was relieved entirely before the conclusion of the treatment, and he had a quiet, refreshing sleep after he had been removed to his bed. The evening temperature was 102.5° F., as against 103.4° F. on the previous day.

Next morning, at eight o'clock, his temperature was 99.9° F., pulse 84. The patient had slept several hours during the night. The pain had not returned to any great degree, and the prostration and nervous symptoms were greatly lessened. The swelling in the hand and arm were less, as was also the enlargement of the glands in the axilla. He was given another body treatment at noon at 350° F. His temperature was 101.8° F., pulse 80, as against 102.5° F. and 94 respectively the preceding evening.

Treatment was administered again late in the afternoon. Morning temperature the next day was 99° F., pulse 78. Patient had slept at intervals during the night and during the day, resting quietly. That evening his temperature was 100.4° F., pulse 76. Pain and swelling had entirely gone out of the arm, but the axillary enlargement persisted, as did also a considerable amount of pain in this region.

The following day, March 7, his morning temperature was 99.4° F., pulse 76. In the afternoon he was given a body dry hot air treatment at 350° F., and the next day his temperature in the morning was 99° F., pulse 70. In the evening the temperature rose to 100.6° F., with the pulse averaging 88.

At this time palpation of the axillary enlargement demonstrated the presence of pus, and it was decided to open the axilla the next day, which was done at four o'clock in the afternoon, Dr. Cheney operating. Upon incision, a large quantity of fluid pus was evacuated and a pocket was discovered running up under the clavicle for a distance of about three inches, of a diameter sufficient to admit of exploration with the forefinger, *but no glands outside of it were involved in the infective process.* It will be observed that this is a very different picture from that usually encountered under these conditions, where the contents of the abscess cavity consist of pus with a plentiful admixture of cheesy detritus, which it is not at all easy to remove in a thorough manner, and where gland after gland is found to be infected, necessitating a vast amount of dissection, in order that the extirpation shall be complete.

The abscess cavity was curetted out and the subsequent progress of the case towards recovery was rapid, satisfactory, and uneventful. On March 13 the body temperature returned permanently to the normal point, and he was discharged on March 23, just three weeks after his admission, entirely recovered from an attack of septic infection which was very evidently seriously threatening his life when he entered.

This case illustrates the necessity of combining operative interference with dry hot air treatments in those cases where such structures as lymphatic glands have become diseased to such an extent that disintegration is inevitable, or when pus accumulations are present. The immediate improvement in the patient's general condition after the first dry hot air treatment, together with the strenuous localization of the inflammatory process in the axilla, illustrate respectively the happy influence of this measure in lessening general systemic toxæmia, and in preventing the spread of the infection from structure to structure, through its power of increasing the physiological resistance of the cells composing the threatened areas.

Case III.

Mr. A. W. A., aged fifty-one years, was admitted to the New York Hospital on the morning of January 8, 1902, with a traumatic amputation of the left foot at the ankle, sustained in a railroad accident. The crushed member was attached to the leg merely by the lacerated posterior tendons, and the patient, of course, was suffering considerably from shock.

Amputation of the lower third of the leg was done by Dr. Francis Marcoe that afternoon. Septic infection, however, declared itself three days after the injury. On January 12 it was noticed that the knee was swollen; on January 15 pus began to discharge from the wound, and in spite of the utmost care the condition increased until January 23, fifteen days after the original injury. At this time the leg up to the knee, and somewhat above this joint, was enormously swollen, the tissues of the stump were sloughing in places, and the patient's general condition was one of extreme prostration. In short, he presented a typical picture of the severest form of blood-poisoning, except that streptococci had not been found in his blood.

It was decided to amputate the infected member above the knee as a forlorn hope. This was done by Dr. Frank Hartley on the evening of January 23, at the middle of the thigh.

Patient rallied very well from the operation, and the next morning was given a body dry hot air treatment.

During the time intervening between January 24, the day of the second operation and March 8, the day of his discharge from the hospital, the patient received thirteen body treatments, the greater number of which, of course, were given during the two weeks immediately succeeding the amputation of the thigh. His general condition began to show slight evidences of benefit at once in the way of increased comfort, ability to sleep, and improvement in the vital signs, and he continued to gain slowly but steadily until by February 5 his improvement had become so manifest as to justify a prognosis of recovery with a moderate degree of certainty. From this date on his improvement was entirely satisfactory; to-day his general condition is better than it has ever been in his life before, and he weighs more without his leg than he ever did with it.

In order to indicate the gravity of the case, I will say here that it was the unanimous opinion of the physicians who saw him that neither the operation or any other ordinary therapeutical measure would save the patient's life. The fact, also, that slight evidences of tissue disintegration appeared in the wound three days after the second operation, is indicative of the fact that the operation and therapeutical measures other than dry hot air would not have sufficed to secure a successful termination.

As far as I know, this agent has never been called upon to influence a case of septic infection in which streptococci were present in the general blood circulation, or a case of puerperal sepsis, but its physiological action, and what is known already of its clinical possibilities, indicate that it would be of assistance in even these ordinarily desperate conditions.

TREATMENT.

Local Dry Hot Air Application.—With cases belonging in the first-mentioned category, local treatment of the affected limb is usually sufficient to effect a cure. The technique does not differ from that usual to the local treatment, and the temperature should be run up to 300° or 400° F., according to the tolerance of the patient.

In cases of the second and third classes, the local treatment

is rarely indicated except to relieve pain or to hasten sluggish healing processes, because, as before stated, the menacing lesions are too deeply located to render possible its effective application.

General Dry Hot Air Application.—This measure is not called for in cases of the first class, unless considerable general toxæmia is present, but in cases of the second and third classes it is the remedy *par excellence.*

The technique is that usual to this treatment, except that we cannot use the temperature of the patient as a guide to the duration and intensity of the application, because it is usually considerably elevated when the patient is placed in the apparatus. The pulse also is not entirely reliable as a guide. We have to be governed more by the effect upon the organism as a whole, and the instinct which is the result of experience is most valuable in this connection. In general, however, it may be said that the treatment should last not less than twenty minutes, and that the temperature required will vary from 250° F. to 350° F. The response on the part of each individual patient at each séance will govern both intensity of the heat and duration of the application. As a rule, it will not be wise to push the pulse above 140 beats per minute, and the symptoms noted under " Technique of the Body Treatment," as indicating excessive stimulation, should be carefully avoided.

Usually the first indication that the toxæmia is diminishing is a lessening of the nervous erythism, which becomes manifest immediately after, and sometimes before the conclusion of the first treatment, when the patient frequently falls into a refreshing sleep lasting from one to several hours.

The augmented functional vigor of the deep spinal sympathetic nerve centers is evidenced before the patient leaves the apparatus by the improved character of the pulse, within four or five hours by a fall in the body temperature, and within twenty-four hours usually, the re-invigoration of the trophic functions is manifested by a marked lessening or a sharp localization of the local inflammatory phenomena.

A point deserving of consideration when treating these cases is that when a patient has been severely septic for several

days, as many have been before they are given the benefit of dry hot air, his nervous system exhibits the irritability of depression to a marked degree, and he is not able to endure the body treatment for half an hour. Under these circumstances the heat should be run up quickly, for instance to 300° F. in fifteen minutes. By this means a quick and effective stimulation may be induced before the patient's endurance is exhausted, whereas, if the temperature ran up as slowly as would ordinarily be the case, it would not be possible to secure the necessary deep reflex response without forcing the length of treatment beyond a judicious limit.

Additional Remedial Measures.

Diet.—The management of the ingesta does not differ in any particular from that ordinarily indicated in this condition.

Drugs.—Medicines are useful to keep the bowels open and to correct digestive derangements; magnesium sulphate for the former and digestive ferments, with small doses of strychnia for the latter. It is, however, very rarely indeed necessary to give them to relieve pain or for stimulation, after the administration of dry hot air is begun.

Operative Interference.—The aid of surgical measures should be promptly enlisted whenever glands or other structures have become diseased beyond the possibility of repair, or so that their further preservation involves serious menace to the patient, and when suppuration has become established. Dry hot air will not remove moribund tissues or pus. Its great functions in suppurative cases are to relieve pain, prevent the infection from spreading to contiguous structures, lessen the systemic toxæmia, and hasten repair of damaged structures, and these it accomplishes nobly and well.

It is not necessary to protect operation wounds during dry hot air applications with more wrappings than the rest of the body, and the proper surgical dressings will ordinarily be sufficient. The healing of such wounds is hastened by the treatments.

Electricity.—Electricity never enters the therapeutical problem when dry hot air is available, except to assist in healing

sluggish sinuses. Here the negative pole of the galvanic battery, applied to the offending granulations through a bare metal electrode, using from three to five milliamperes of current for five or ten minutes, will do more execution than any other measure with which I am familiar. Care should be taken not to use enough current to cauterize; the good results are effected by electrolysis, not by destruction.

CHAPTER VII.

PNEUMONIA.

Modifications of Clinical Conditions producible with Dry Hot Air.

Local Application.

First, immediate relief of pleuritic pain lasting for from one to eight hours, which is conducive to the patient's comfort, hence conservative of his vital energy.

Second, relief of that proportion of the cough and respiratory embarrassment due to the pleurisy.

Third, a marked inhibitive influence exerted upon the growth of the pneumococcus colonies in the area of consolidation whereby the circulation and nerve centers are relieved from a large proportion of the toxin depression and irritation which result from their unimpeded development, and a decrease of febrile movement of from half a degree to one degree Fahrenheit is usually secured within twelve hours.

Fourth, rapid absorption of the exudate to such an extent that the physical signs of consolidation entirely disappear in from one to four days after the first application, which diminishes the danger of cardiac distention and removes the symptoms caused by encroachment upon functionable respiratory areas.

General Application.

First, a reflex stimulation of the vital powers unparalleled in extent and profundity by that producible with any other measure, and which is evidenced by marked improvement in the circulatory function before the patient leaves the apparatus.

Second, relief of the pulmonary blood-vessels by a dilatation of the peripheral circulation, the extent of which again is unsurpassed, if not unequaled, by that obtainable with any other measure now known.

Third, elimination of toxins already formed and in the blood, to an extent and with a rapidity unattainable by any other means.

Fourth, reduction of excessive body temperature amounting to from half a degree to a degree and a half Fahrenheit, and marked improvement in the general symptomatic phenomena, within five hours after administration.

The writer was first led to use this agent in pneumonia by his observation of its kindly influence upon a case of peritonitis, and the first case of pneumonia so treated was reported in the *New York Medical Journal* for October 2, 1899. The agent was applied to this case more in the hope of relieving the pleuritic pain than of influencing the pneumonic process, but to the writer's surprise and gratification the general and local pneumonic symptoms were mitigated as well as the pleurisy, and in subsequent cases it has confirmed its claims to respect then put forward as a therapeutical measure with which to attack this infection. At the present time the writer believes that judiciously and thoroughly (I desire to emphasize these two adjectives) applied dry hot air treatments constitute one of the most efficient means now known for combating this disease.

RATIONALE OF THERMOTHERAPY.

A brief consideration of the etiology and pathology of the disease is necessary in order that the rationale of its power to produce these results may be comprehended, and the conception of the same put forward by Dr. Andrew H. Smith, of New York, N. Y., carries with it more conviction than any other of which I am cognizant. In addition, it offers plausible explanation of the action of dry hot air in this disease. Briefly, Professor Smith's explanation is as follows:

Etiology and Pathology.—The primary etiological element consists of the development of cultures of pneumococci in the pulmonary alveoli, from which toxins are absorbed into the circulation, and produce the general systemic disturbance, including "heart failure." The pabulum for the growth of the micro-organisms is constituted by the fibrinous exudate which

pours into the alveoli because of the irritation of their walls by the presence of the germ colonies.

That it is not an inflammation of the lung tissue in the ordinary sense is indicated by the fact that any such inflammatory process of a sufficient intensity to produce the clinical phenomena of pneumonia would very surely be followed by irreparable destruction of large masses of pulmonary tissue, whereas, in this disease after the process has subsided, the integrity of the lung structure is usually entirely restored; and that autopsical findings demonstrate that the bronchial or nutrient circulation is very rarely involved at all, but that when it is, gangrene of the areas strangulated is very sure to result.

This means that obstruction of the pulmonary or functional circulation by the exudate, and reflex pneumogastric irritation due to the same cause, are probably responsible for the greater part of the respiratory, and much of the cardiac disturbance observed in uncomplicated pneumonia.

The life of the pneumococcus in artificial cultures is from ten to twelve days, and it is one of the most sensitive of all bacteria to changes in the conditions of its pabulum as regards temperature, reaction, etc. It grows best in faintly alkaline media, and a marked acidity will entirely inhibit its development, hence the fibrinous exudate in the air-cells constitutes an ideal culture medium.

During the process of hepatization pneumic acid forms, and when the saturation of the exudate reaches a sufficiently high point, the further development of new colonies of germs is thereby inhibited. It is by reason of this fact, together with the exhaustion of the culture medium (exuded fibrin), and the possible formation at a certain stage of an antitoxin, that the termination by crisis obtains. Modifications of these conditions produce termination by lysis.

Professor Smith presented the subject in detail in an address to the New York Academy of Medicine, which was published in the *Medical News* for December 18, 1899. During the course of this address he states his "views as to the sequence of events taking place in an attack of pneumonia," to be as follow:

"1. The occurrence of some cause of depression, either local or general, which favors the germination of pneumococci, already present in some one of the smaller tubes.

"2. The formation of a colony that spreads until it reaches the group of air-vessels that are terminal to the tube in question.

"3. The setting up of an irritation in these vessels, causing a fibrinous exudation, an emigration of leucocytes, and a diapedesis of red cells from the functional capillaries.

"4. The formation of a colony of pneumococci in the medium afforded by this exudate.

"5. Arrest of the blood stream in the functional capillaries, followed by accumulation of free pneumic acid in the parenchyma of the affected area.

"6. Overflow of exudate into neighboring lobules, starting the process in them also.

"7. Arrest of germ growth by the exhaustion of the medium and the accumulation of free acid in the tissue of the lung. Up to this time there has been a constant formation and absorption of toxin.

"8. Retrogressive changes in the exudate preparatory to its removal by absorption.

"9. Probably, in this latter process, formation of an antitoxin principle.

"10. Entire removal of the exudate, and restoration of the vesicle to its normal condition.

"11. Resumption of the functional capillary circulation."

The points to be borne in mind in considering this part of our subject, then, are as follow:

First, the diplococcus of Fränkel is an organism exquisitely sensitive to changes in the temperature and character of its pabulum, and its life period in laboratory cultures is from ten to twelve days.

Second, we have a condition here which is closely analogous to that which obtains when cultures of the organism are grown in the laboratory; the walls of the pulmonary alveoli acting as test-tubes and the exuded fibrin as culture medium, to appropriate another of Professor Smith's apt expressions.

Third, when consolidation has taken place, the layers of the pleuræ being in apposition, and even sometimes absolutely adherent, from fibrin exudation, we have practically a solid tissue from the integument to the inner limit of the consolidation, except in those comparatively infrequent cases where the consolidation is central exclusively.

Fourth, the general systemic phenomena, including "heart-failure," are due to the influence upon nerve centers, muscles, and glandular structures, of toxins emanating from the germ cultures in the alveoli and absorbed into the blood.

Fifth, the most virulent toxins are produced where the colonies are youngest, hence come from the periphery of the affected area where the cultures are thinnest and spreading into other alveoli.

Sixth, in many cases, much of the cough and a considerable proportion of the respiratory acceleration, are due to reflex irritation and pain, set up by the pleurisy which usually accompanies the trouble. A bit of clinical evidence in favor of this probability is that local dry hot air applications do not immediately diminish the respiratory acceleration or cough much, *unless pleurisy is present.*

Seventh, death is directly due either to paralysis of nerve centers from toxin absorption, or paralysis of the right heart from over-distention of the ptomaine-impaired viscus precipitated by massive exudate.

Therapeutic Indications.—The objects of treatment may be briefly stated as follow:

First, to secure the destruction of the colonies of pneumococci in the lung, or, failing this, as profound an inhibition of their development as possible, whereby the quantity or virulence of toxins introduced into the general circulation would be diminished.

Second, to secure as rapid and profuse an elimination of the toxins already in the body as possible.

Third, to secure absorption of the exudate as rapidly as possible.

Fourth, to relieve pleuritic pain when present.

Fifth, to increase the patient's vitality and metabolic ac-

tivity, whereby his physiological resistance and recuperative capacity will be augmented.

Local Application.—Now, when a local dry hot air treatment is administered over a consolidated lobe, it is reasonable to infer that the heat could be made to penetrate in some degree nearly, if not quite, through the whole of the affected area by conduction, as the part is then practically a solid tissue, and the heat is applied to the front and back, as well as the side of the chest over the affected region.

If this is true, then the temperature of the pabulum of the invading micro-organisms could be raised, and one of the most essential conditions of their well-being disturbed. We have seen that it is only in the absence of a disturbance of these conditions that this germ is able to grow at all, hence this result would very certainly exercise an inhibitory influence upon its development, from which would result a lessening of the quantity and virulence of the toxins formed.

As the general symptomatic phenomena are due to absorption of these same toxins, any influence which lessened their quantity or virulence would also lessen the intensity of the general symptoms, and we should expect, as a result of the application of such an influence, a drop in the body temperature and a considerable amelioration of the depression of the nerve centers; and bedside experience proves this deduction to be true.

But the question at once arises, "If this is true why would it not be possible to abort pneumonia, to cut the attack short at once with the local dry hot air treatment?"

We have seen that the germ colonies tend to invade other air-cells and bronchioles by spreading from the periphery of the consolidated area, and that these youngest, peripheral colonies give rise to the most virulent of the toxins. Those air cells and bronchioles, which have been newly invaded, are not yet consolidated, hence have not yet become solid tissue, and air circulates through them. It would, therefore, be impossible to raise the temperature of these parts very markedly if at all, and the inhibitory influence susceptible of induction in the fully consolidated portion could not be attained here.

These colonies, therefore, would continue to multiply and spread until they had reached the end of their normal life period, and the system at large would continue to feel the effects of such toxins as emanated from these areas, although relieved from those formed in the original and larger focus.

As a consequence, we should expect some fever, acceleration of pulse and respiration, general prostration, etc., to continue until the natural period for the termination of the attack had arrived, and this is exactly what happens. The patient, being relieved from a large degree of the intoxication from the greater bulk of the infective focus, exhibits a marked and immediate improvement, but does not recover entirely until the infection has reached the period of its normal defervescence.

Further, in this connection, it would be expected that, if the dry hot air applications were discontinued too soon, the germ colonies at the periphery of the original focus of infection would again multiply, so as to produce some amount of consolidation and an increase in the systemic disturbance. Bedside experience also confirms this expectation.

A final logical inference would be that central pneumonia, where a layer of functionating air-cells interposed between the focus of the infection and the dry hot air apparatus, would fail to respond to the treatment as well as the ordinary form where the consolidated area constitutes a practically solid tissue continuous with the external skin, thus facilitating conduction of the heat; and experience so far indicates that this also is true. In the small number of cases of this variety of pneumonia that has come under my observation since I have been using this therapeutical agent, the reaction has been much less satisfactory; but even here that benefit was derived was unmistakable.

There is another possible explanation of the effect of local dry hot air applications upon pneumonia, viz., that the direct and reflex acceleration of metabolic processes in and about the consolidation results in the *immediate* production of an acid reaction in the exudate whereby the development of the germ colonies would also be inhibited. As has been stated, the evolution of pneumic acid is a natural phase of the later stages

of the phenomenon of consolidation, and the logical tendency of thermo-therapeutical applications would be to hasten the natural sequence of metabolic events. The former solution of the problem appears at present to be the more probable, but this one deserves consideration in this connection.

It is significant, with reference to the foregoing, that Dr. Beverley C. Kinnear, of New York City, used heat with beneficial results in the treatment of pneumonia, in the form of hot-water bags or flannels wrung out of hot water, continuously applied, previous to 1898. His paper upon this subject was published in the *Boston Medical and Surgical Journal* for December 2, 1897. He made his applications over the dorsal sympathetic ganglia, and believed the effect to be due to reflex influence exerted upon and through these structures. Is it not possible, however, that the benefit was due, in part, at least, to a greater or less inhibition of germ growth through the raising of the temperature of the adjacent structures, muscles, pleuræ, etc., and through those of portions of the contiguous consolidation?

The application of cold in the form of ice packed about the chest has also been employed with benefit in this disease. This measure would unquestionably exercise a certain amount of inhibitory influence upon the growth of pneumococcus colonies, by lowering, in some degree, the temperature of at least portions of the consolidated area, but it would not stimulate absorption or metabolism; on the contrary, cold retards these processes, hence this measure would not be expected to produce the same degree of beneficial effect as intense dry heat. The patient's vitality, as represented by his reactive powers, constitutes a large element in securing a favorable effect from cold applications. When heat is employed, this factor does not enter the equation, as he has had nothing administered that demands reaction for the development of its benefits; its favorable influence is direct and inherent.

An incontrovertible elucidation of the exact manner in which these effects of hot and cold local applications in pneumonia are brought about is at present impossible, nor is it necessary for our present purposes. The vital point is that they are

brought about, and that this is so is attested by a large number of competent clinical observers.

General Application.—Occasionally a case is encountered where the patient's excretory organs are incapable of eliminating the toxins with sufficient rapidity, and a depression of nerve centers develops which threatens speedily to end the scene and the patient.

This condition may be brought about by defective renal function, a low condition of the patient's vital powers when the infection was sustained, or a particularly virulent type of infection. Whichever the cause, the local treatment is ordinarily useless, because it could not possibly influence the kidney to any degree when applied to the lung; the small area of skin subjected to its influence does not contain enough nerve endings to make possible a reflex stimulation of the spinal centers profound enough to overcome a general debility of this character; and, as has been seen, the most virulent toxins emanate from the youngest colonies of germs, which are so placed in the periphery of the area of consolidation as to be beyond the penetrative limit of the local application. The only resource then becomes the induction of profuse and rapid elimination from a larger area of the skin, a rousing of the kidneys and lungs to increased function, and a strong stimulation of the spinal centers which are being overwhelmed, and the body dry hot air treatment enters the arena. As will be seen by referring to its physiological action, it possesses the power to accomplish all of these objects in an eminent degree, and the method of its application will be described in a subsequent section.

ILLUSTRATIVE CASES.

The following instance exemplifies very well the effect of the local application upon the ordinary case of pneumonia:

Case I.

Mr. G. W. P., age thirty-four years, a clergyman by occupation. I saw the patient first on March 29, 1900, at 9 A. M. He had been in his usual health until the preceding evening, when he had begun to feel "badly all over," and had noticed a sharp pain under his left nipple. This had grown worse during the night, and towards morning he had begun to cough

some, which increased the pain, as did also deep respiration. Auscultation and percussion elicited nothing abnormal. His pulse was 76 per minute, respiration 20, temperature 98.6° F. It looked like developing influenza, and the patient was sent to bed and an anodyne cough mixture prescribed.

March 29, 7 P. M. The cough had increased during the day and the pain under the nipple was now harassing in the extreme. Severe headache had developed, but there was no expectoration. Pulse was 100 per minute, respiration 48, temperature 101.6° F. Physical examination discovered a few crepitant râles and a marked pleural creak, but no dullness. I made a diagnosis of commencing pneumonia, directed that a hot-water bag be applied over the site of the pleurisy, and that five grains of antikamnia be given every hour until the headache was relieved.

March 29, 11 P. M. The pain had lessened somewhat under the influence of the hot-water bag and ten grains of antikamnia, and this drug was then discontinued. Slight dullness had developed over the lower lobe of the left lung. Pulse was 98, respiration 48, temperature 100.6° F.

March 30, 8 A. M. Patient had been very restless during the night, and had slept but little. Headache and pleuritic pain had increased after midnight, and were now again extremely harassing. He was expectorating a green viscid mucus, which adhered to the bottom of an inverted dish. Pulse was 100, respiration 42, temperature 100.8° F. Dullness was now marked over lower lobe of left lung.

Patient was greatly prostrated, and his pain, frequently exacerbated by coughing, was increasing his prostration, but I hesitated to give him morphine because he was of a markedly neurotic temperament, and I also feared the respiratory depression so frequently dependent upon its administration under these conditions. I decided to try Baume Analgesique, applied over the pleurisy with a hot-water bag over it, and directed that I be notified if no amelioration occurred by 11 o'clock A. M.

I was so notified, and decided to treat the consolidated lobe with dry hot air, which was done at noon. At the end of the treatment the pleuritic pain was entirely relieved, except when coughing violently or upon forced respiration, and the pulse had dropped to 96, respiration to 28. During the morning the sputum had become blood-stained, and was now typically pneumonic.

March 30, 8 P. M. The pleuritic pain had remained in abeyance until 6 P. M., but had been very severe since. Pulse was 100, respiration 56, temperature 103° F. Dry hot air was again

administered, completely relieving the pain as usual, and at the end of the treatment the pulse was 94, respiration 38. I left the patient resting quietly.

March 31, 9 A. M. He had continued to rest comfortably until 2 A. M., when the pleuritic pain had begun to return, and it was now severe again. The cough had greatly lessened and what little sputum he raised was rusty and very tenacious. Pulse was 96, respiration 32, temperature 102.2° F. The dullness over the affected lobe was markedly less, and numerous coarse râles were present. Dry hot air was administered.

March 31, 9 P. M. Patient had no pleuritic pain during the day, but at 8 P. M. it had returned nearly as severely as before. Sputum had become much lighter in color during the afternoon, and was much less tenacious. Percussion betrayed only a very small area of slight dullness over the affected lobe, and the coarse râles, so plentiful in the morning, were disappearing. Pulse was 100, respiration 30, but had dropped to 28 at noon, and temperature was 102.2° F. Dry hot air was administered.

About fifteen minutes after treatment was begun the pleuritic pain disappeared, and patient remarked how good it seemed to be free from it. Shortly afterward he exclaimed, "Oh, how queer I feel!" I asked him what the matter was and he tried to, but could not answer. His eyes closed, muscles relaxed, and he appeared to have fainted. I felt the pulse; it was very soft, and the respiration, as well as the pulse, had become very slow. His lips were blue and the skin on the face ashen. I immediately removed the apparatus, threw the clothing from his body, and had the nurse fan him vigorously, while I opened a window and got a hypodermic of strychnia ready. It was not needed, however, as in a minute or two he revived, opened his eyes, and his pulse and respiration resumed their former rate and character.

By evening of the next day, April 1, the physical signs of consolidation had entirely disappeared, but râles were still present, and they persisted in some degree in this situation for about a week.

From this time until April 4 the only noteworthy event was an acute œdema of the lungs, lasting about six hours, which occurred in the morning of April 2. For thirty-six hours previously the patient had suffered from a headache which had utterly resisted the ordinary analgetics, and which had become so severe that I was obliged to resort to morphine hypodermically during the night of April 1. The œdema yielded to hypodermics of strychnia and atropin in about five hours.

Shortly after midnight of April 3 the patient became slightly

delirious, and about three o'clock in the morning of April 4 pleuritic pain appeared over the lower lobe of the right lung. I saw him at 8 A. M., at which time his pulse was 104, respiration 38, temperature 102.4° F. The original focus of infection in the lower lobe of the left lung was in a satisfactory condition, but dullness had appeared over the lower lobe of the right lung. I called again at noon and found that the dullness which was present in this situation in the morning had increased to flatness, and the sputum was bloody. The general condition was about the same as in the morning. Dry hot air was applied over the lower lobe of the right lung.

April 4, 10 P. M. Patient had passed a very comfortable afternoon. Sputum was rusty. Pulse 106, respiration 36, temperature 101.6° F. The flatness over the lower lobe of the right lung had decreased to dullness, and dry hot air was administered again in this situation. During the evening Dr. Rollin McNeil, of New Haven, saw the case with me in consultation, and did me the honor to observe its subsequent course. As the patient was excessively prostrated, I remained with him during the night.

April 5, 8 A. M. Patient had developed a severe lumbar myositis in both sides, but especially marked in the right, which had first manifested itself about 4 A. M. Spasms in the affected muscles were frequent and painful, and extreme tenderness to the touch was present. I directed that mustard pastes be applied over the affected structures.

April 5, 10 P. M. Muscular spasm and pain had been only slightly relieved by the sinapism, and the patient had suffered considerably from them during the day. The slightest movement on his part, or manipulation by anyone else, would set up the spasm. Pulse was 94, respiration 34, temperature 100.2° F., and general condition much the same as in the morning. Physical examination demonstrated that dullness was present only in spots over the lower lobe of the right lung, and that air was entering pretty freely every part of it.

Dry hot air was administered again and the cloth attachment was carried downward and backward so as to include the inflamed muscles. At the end of the treatment the patient could cough, respire deeply, and move about in the bed, and the parts could be manipulated without causing spasm or pain. The patient's continued extreme prostration decided me to remain again by his bedside during the night.

April 6, 8 A. M. Patient had passed a very comfortable night, sleeping most of the time. Had suffered slightly from muscular spasm about 2 A. M., but at this time only very slight soreness upon manipulation was apparent, and patient could

move freely without exciting any spasm or pain. Sputum had lost its rusty character and was opaque, whitish, and somewhat frothy. Pulse 92, respiration 28, temperature 99.2° F. Dullness had disappeared entirely from the lobe last affected, but some râles were still present in this and also in the lower left lobe.

From this time on the patient's recovery was steady and uneventful, except for a short, but pretty sharp, return of the myositis on April 8, which was readily controlled by dry hot air locally. The temperature returned permanently to the normal on April 22, with a pulse of 76, and respiration of 18, but it had not been higher than 99.2° F. after April 4. The extreme prostration, which had caused me so much anxiety on April 5 and 6, had disappeared rapidly after April 8, and the convalescence was entirely satisfactory in every respect.

It will be observed that in this case the administration of dry hot air was followed by the results noted below.

First, immediate relief of the pleuritic pain, which relief lasted for several hours after treatment.

Second, a decrease in the frequency of respiration, probably due to relief of the pleuritic pain, and which on the evening of March 30 amounted to twelve cycles per minute.

Third, lessening of the cough.

Fourth, a drop in the body temperature amounting to from half a degree to one degree, F. It will be observed that after the second treatment the temperature did not at any time rise above 102.2° F. until the morning of April 4, when the right lung became involved, and even then it only reached 102.4° F., an unusually low temperature for an ordinarily severe case of pneumonia.

Fifth, entire disappearance of the physical signs of consolidation within forty-eight hours after the first treatment was administered.

It also exemplifies, during the administration of the treatment on the morning of March 31, the cardiac disturbance that sometimes occurs when the lower lobe of the left lung is being treated.

As previously stated, when profound general toxæmia is present, the general application is the measure to be employed, but that the influence of the local application upon the toxin-

producing factors at the site of infection is, in rare instances, sufficient to avert a fatal termination was evidenced by a case which occurred in the practice of Dr. B. S. Lewis, of New Haven, Conn.

Case II.

The patient, a woman, about fifty years of age, had been suffering from pneumonia in the lower lobe of the right lung for several days and had become comatose from toxæmia during the late afternoon of May 4, 1900.

Dr. Lewis called Dr. Rollin McNeil in consultation upon the case; they agreed that no ordinary therapeutical measure offered any hope of saving the patient's life, and invited me to administer dry hot air.

I repaired to the patient's bedside at once, in company with the gentlemen just mentioned, and administered the first treatment at 11 o'clock, P. M. At this time the patient could not be aroused, subsultus tendinum was present, her pulse was 130, weak, compressible, and thready, respiration 33, and she was evidently failing rapidly; no pleurisy was or had been present. The pulse improved before the treatment was concluded, and shortly afterward the nervous symptoms decreased, but the respiratory acceleration showed no sign of abatement for several hours, *probably because no portion of it was due to pleurisy.* When we called to treat her again the next morning she was conscious, the pulse and other symptoms had continued to improve, and she went on to convalescence and complete recovery.

Other cases in which I have relied upon the local application to overcome profound general toxæmia, however, have died, and I do not now consider it justifiable to postpone the body treatment under these conditions. One of the fatal cases just referred to, occurring in the practice of Dr. Walter C. Skiff, of New Haven, Conn., was of particular interest because of the fact that the physical signs of consolidation had almost entirely disappeared eighteen hours after the agent was first applied, yet the patient died in a few hours just the same; a bit of evidence tending to confirm the hypothesis that the most virulent of the toxins emanate from the colonies of pneumococci at the periphery of the region of infection, and which are beyond the reach of the inhibitive influence of the local application, as described in a preceding section.

TREATMENT.

Local Dry Hot Air Application.—The local application of this agent is, in many cases, the only thermo-therapeutical measure required in pneumonia, and the appropriate technique is as follows:

A piece of cheap Turkish toweling, four or five feet long and eighteen or twenty inches wide, is folded twice, so as to make three thicknesses, and applied closely against the skin over the affected portion of the lung. This is held in place by two or three pieces of webbing one inch in width, supplied with buckles at one end, and long enough to pass clear around the body. The patient is then brought close to the edge of the bed and supported by pillows in such a way that the apparatus can be attached directly over the area to be treated.

The heat should be run up to from 275° F. to 350° F., according to the patient's tolerance, and the duration of the treatment should be from half an hour to an hour. Victims of this disease find it extremely irksome to lie in one position with the affected lung uppermost, for an hour, but the treatment should be continued for this length of time if it can be done without provoking undue exhaustion, and judgment and experience must govern on this point. Treatments of less than half an hour are of little, if any, use.

When treating the lower lobe of the left lung, it should be borne in mind that acute dilatation of the heart is sometimes induced, either by reflex influence or conduction of the heat to the organ through the area of consolidation, and the pulse and respiration should be constantly watched. If untoward symptoms appear, the apparatus and wrappings should be immediately removed, and the patient's body exposed and fanned. Usually this will take care of the condition in a few seconds, when treatment may be resumed. If the patient does not revive at once, towels wet in cold water should be slapped over the chest and abdomen, and strychnia injected hypodermatically.

After-Care.—When the treatment has been completed, the capillary area which has been subjected to its influence will

XXIII.—Local Application of Dry Hot Air to Left Lung or Pleuræ.

be found to have become deeply injected and covered with profuse perspiration. This secretion will also usually be in evidence to some extent on other parts of the body. It may be removed with a dry towel, the area treated wrapped in one thickness of flannel, and the patient made comfortable again in bed, but no other after-applications are necessary. It will be seen that poultices and pneumonia jackets are entirely uncalled for when dry hot air is obtainable, hence the patient and his attendants are spared the exposure and discomfort contingent upon their use.

The application should ordinarily be repeated every twelve hours for the first two days, and once daily thereafter until convalescence is established.

General Application.—The patient is prepared for treatment in the usual way and placed in the apparatus, and the heat is run up as rapidly as possible to 275° F. or 300° F. If perspiration or marked flushing of the face is not induced by this temperature, the same should be increased until it is, or until the patient's tolerance is reached. The treatment should last from twenty minutes to three-quarters of an hour, according to the effect produced.

As the body temperature of the patient is usually already high when he enters the apparatus under these conditions, it is useless as a guide to the duration of the séance, and the pulse and general effects must be relied upon for guidance; another situation where good judgment and experience are friends in need and in deed. In a general way, however, it may be said that the pulse should not be accelerated beyond 140 beats per minute, and that when sedation of the nervous system or dilatation of the capillary circulation—as evidenced by decided flushing of the face or general perspiration—has been induced, it is time to stop. Over-stimulation means exhaustion, which should be avoided, and a patient in the extremity we are considering is especially susceptible to its induction.

The after-care does not differ from that of the body treatment in general. The beneficial influence of the treatment upon the heart and nervous system is frequently apparent while the patient is still in the apparatus, and it lasts from twelve to

twenty-four hours usually. The application may be repeated when the patient begins to fail again.

Heart Failure.—This symptom is sufficiently important to merit brief special mention in this connection. It is due either to massive exudate or systemic toxæmia, or a combination of both. Massive exudate will usually yield to the influence of the local treatments with sufficient readiness to save the patient, but these applications are not effective in relieving the symptom when due to systemic toxæmia. The body treatment only is efficient here, and in view of the fact that the patients almost always die under all other methods of treatment when reduced to this extremity, it is justifiable to move them in an ambulance from their homes to a hospital if they cannot be gotten to a body apparatus in any other way. As the treatment would be applied immediately, the evil result of any ordinary exposure sustained during the journey would be remedied at once, and the patient would thereby get the benefit of almost the only therapeutical measure that offers him a reasonable hope of recovery.

Additional Remedial Measures.

The other forms of physical therapeutics never enter the problem of the treatment of this disease when dry hot air is obtainable, but medicines are important.

Drugs.—Professor A. H. Smith, cited previously, advocates the administration of drugs which are excreted largely by the lungs, and which are inherently inimical to the development of the pneumococcus. The extreme sensitiveness of this organism to conditions pervading its pabulum renders several drugs available for this purpose, among which may be mentioned creosote carbonate, the salicylates, large single doses of calomel, and quinine; under ordinary circumstances the administration of these substances is not deleterious to the patient.

The two first mentioned are Professor Smith's choice, the clinical results he reports are excellent, and the author desires hereby to add his testimony to that of other observers, as regards the favorable influence of creosote carbonate, at least.

The weak point in this method of attacking the germs is that

some stomachs, kidneys, and nervous systems cannot stand the drugs advocated in sufficient quantities to render possible the induction of their antiseptic influence, and that medicines excreted in this manner do not penetrate to the germ colonies deeply located in the consolidated area. They do, however, reach the youngest of the colonies, which are spreading at the periphery of the consolidation and giving rise to the most virulent of the toxins. As we have seen, dry hot air treatments exert their most powerful influence upon the area of consolidation, hence, by combining these with the administration of appropriate germicidal drugs, we secure the most effective inhibitory influence possible at the present time.

The drug management of the symptomatic phenomena of the disease does not differ from that applicable under other circumstances. Strychnia, whisky, sanguinaria or sanguinarin, small doses of tartar emetic, bryonia, phosphorus, etc., all have their places as stimulants, expectorants, etc., but when dry hot air is given they will sometimes never be indicated at all, and when they are it will be for a shorter time and in much smaller quantities than under other conditions.

When the respiratory area has been greatly encroached upon, oxygen inhalations are extremely helpful and constitute a fairly efficient nerve stimulant as well.

CHAPTER VIII.

ALBUMINURIC NEPHRITIS (BRIGHT'S DISEASE).

Modifications of Clinical Conditions producible with Dry Hot Air.

Local Application.

This measure exercises no appreciable influence upon the essential characteristic symptomatology or pathology of the disease, and may be dismissed at once from further consideration in connection therewith.

General Application.

First, relief of the headache, nausea, respiratory and cardiac embarrassment, sometimes before the patient leaves the apparatus, and usually within twelve hours.

Second, increase of the urinary excretion and of the total urea output in cases wherein these factors are deficient, whereby the general toxæmia is lessened.

Third, diminution of the total quantity of albumin voided in the urine, at least when such quantity is large, and sometimes complete elimination of this abnormal constituent.

Fourth, diminution of the dropsy within twelve hours usually, and sometimes its entire disappearance within four or five days.

Fifth, absence of the evil after-effects of drugs which it is sometimes necessary to administer for the control of severe symptoms, because such symptoms are effectually removed by dry hot air, which produces no vicious reaction when judiciously and properly administered.

Sixth, restoration to perfect health of some of the victims of this disease, and to apparent health and unimpaired usefulness of a large number.

RATIONALE OF THERMOTHERAPY.

Etiology.—Unfortunately, a positive knowledge of the primary etiological factors of this disease is not available at the

present time, but the general symptomatology and local tissue alterations are such as to point with a strong degree of probability to the presence in the blood of some bodies irritant to the renal structures during excretion, and which are developed in the tissues by reason of some disorder of the sympathetic nerve centers which govern the functions concerned in tissue metabolism, more particularly oxidation. If this proves to be true, the disease will ultimately have to be transferred from the category of the renal to that of the constitutional disorders; an impairment of general metabolism, of which the changes in the kidneys are but secondary local manifestations.

The manner in which the disease responds to dry hot air applications strengthens this conception of its causation, as does also the fact that the only therapeusis that has ever been of value in the condition is that which has had elimination of some sort, or increase of oxidation in the body as its object. The clinical aspects of the disease are also strongly indicative of systemic toxæmia of some sort.

Speculations as to the primary etiology of the disease are at present fruitless, however, and fortunately positive knowledge upon this point is not necessary, so far as the use of dry hot air in its treatment is concerned. We can derive an ample number of rational indications for its employment from the well-known clinical phenomena.

Symptomatology and Pathology.—Let us consider briefly some of the most prominent and constant of these clinical manifestations, and see if it is possible to deduce anything as to the causative factors, which will constitute a logical basis upon which to construct a rational therapy.

First, there is frequently present dyspnœa of variable degree, which might be due to pressure upon the pulmonary innervation, interference with the respiratory movements through fluid accumulations in the abdominal or pleural cavities, or irritation of the nerve endings in the pulmonary mucosæ by the excretion of abnormal, irritating bodies from the blood current. In most cases the first two of these possible causative factors can easily be excluded.

Second, dropsy, which might be due to change in the blood

pressure from insufficiency of the cardiac or arterial impulses, changes in composition of the blood serum, or irritation of endothelium from toxic bodies circulating in the blood current.

Third, digestive disturbances, which could also be due to excretion by the alimentary mucosa of toxic bodies present in the general circulation.

Fourth, a variable degree of bronchitis, indicating an abnormal, irritant condition of the excretions of the pulmonary mucosæ.

Fifth, affections of the skin, explicable upon the assumption of either trophic aberration, or the presence in the integumentary excretion of abnormal, irritant matters.

Sixth, a quickened heart action, accompanied by increased arterial tension, easily explicable upon the assumption that the blood current holds in solution some irritant body or bodies.

Seventh, headache, dizziness, insomnia, increased general nervous and muscular irritability, sometimes eventuating in the most pronounced convulsive seizures; all strikingly indicative of the presence of toxic contamination of the body fluids.

Eighth, the total urinary output in the ordinary chronic form of the disease, is usually somewhat in excess of the normal, with lowered specific gravity, a phenomenon easily interpretable as the result of renal irritation, due to the presence in the blood of an abnormal toxic element. In the more acute seizures or exacerbations, a diminution in quantity obtains which reaches the point of complete suppression when the inflammation of the secreting structures attains a sufficient degree of intensity; and this inflammation again is undeniably dependent upon some antecedent irritation.

Ninth, the fact that albumin is usually found in the urine is explicable upon the same causative hypotheses advanced in connection with dropsy, one of which, it will be remembered, involved the presence of some irritating body in the general circulation.

Tenth and last, the structural changes in the kidneys of true Bright's disease are just such as we should expect to find as the direct or remote result of inflammatory action, which again

presupposes the presence of the element of antecedent irritation.

A general debility of varying degree, frequently amounting to profound prostration, also usually accompanies the development of the renal symptoms.

We have, then, ten of the cardinal elements which combine to form the clinical and pathological picture of Bright's disease of the kidneys, and four of the minor symptoms, for the explanation of every individual one of which the hypothesis that an abnormal substance or substances possessing toxic and irritant properties is contaminating the general circulation would be sufficient; and I do not know of any evidence tending to show that such a product and condition do not exist in this situation, or that their existence would not be sufficient to explain all of the pathological and clinical phases of this ailment.

Nature of Specific Toxin.—The next inquiry that would naturally follow in this line of reasoning would be, "What is the nature and evolution of this abnormal toxic irritant?"

We find that the urine of Bright's disease commonly exhibits a deficiency in the quantity of urea normally present, and the first thought would be that accumulation in the blood of an intolerable amount of this product of catabolism was the offending factor. Indeed, this view of the matter has been very generally accepted until recently, but there exists some evidence tending to show that another solution of the problem invites consideration.

First, although the urine is deficient in urea, yet that does not necessarily prove that the missing quantity has been retained in the blood, as *urea*.

Second, it has been found that urea injected into the veins of animals produces scarcely any general disturbance, *unless the kidneys have been extirpated or their blood-vessels tied off*.

Third, although death always follows the extirpation of both kidneys or ligation of their blood-vessels, yet this does not necessarily prove that death, under these conditions, is due to retention in the blood of urea, and further, uræmic phenomena

do not by any means *always* accompany dissolution under these conditions. The element of shock, which the total destruction of an element so vital to the preservation of the organism as is the renal function, would enter into the problem with a force that cannot be estimated, and that might in itself, and exclusive of all other causes, be sufficient, in its remote reflex and indirect influences upon other functions and the general bodily metabolism to produce death.

Fourth, cases of complete suppression of the urine for periods varying from five to twenty-five days, and exhibiting no increase in uræmic signs, are not so very uncommon in medical literature. In these cases the blood is frequently loaded with urea, and increase in the uræmic symptoms could hardly fail to appear if *urea* were the active cause of them.

Fifth, although the induced perspiration of Bright's disease is said to exhibit a marked increase in its toxic properties, yet the quantity of *urea* found therein bears no adequate proportion to the amount of benefit frequently dependent upon the induction of perspiration.

Sixth, urea in excess is by no means always found in blood drawn during uræmic seizures.

Seventh, urea is a normal, therefore an unirritating excretory product of the kidneys, and no evidence is at hand to indicate that these organs would be unable adequately, and with safety to themselves, to excrete any amount of it which the bodily metabolism was capable of elaborating, or that urea, in itself, is capable of provoking inflammation in these organs, however great the quantity which they may have been called upon to dispose of; and inflammation of the renal excretory structures of some degree is an invariable concomitant of uræmic manifestations.

Eighth, if we assume that an excessive amount of urea in the blood is the essential causative element of uræmic phenomena, we must necessarily also assume that one of two antecedent conditions obtains in order to account for its presence there:

First, that the primary and initial lesion is the inflammatory process in the kidney, by reason of which the kidney is so crippled that it is unable to excrete the normal quantity, where-

by the same is thrown back into the blood current; and there is no satisfactory evidence available to support this supposition.

Second, that some aberration of metabolic function causes urea to be elaborated in such quantities that the kidney is unable to excrete it; and, as stated above, there is no conclusive evidence available to indicate that *urea* is so present, that it would be possible for the organism to elaborate urea in sufficient quantity to produce this effect, or again, that urea would be able in any possible quantity to produce the inflammatory renal pathology which is always observed in this disease.

These facts are vital, and any theory that does not satisfy their claims is not entitled to unmodified acceptance.

Therefore, it would appear that there is justification for looking for something besides urea, as the direct exciting cause of uræmic phenomena, and as inflammation of the kidney structures, which would partake of the nature of an *external* factor, can be disregarded as a primary cause, we must look for the origin at the other end of the equation, that is, *within the body.* Now, urea is a substance of a moderately high degree of oxidation, and, as the clinical phenomena of Bright's disease by no means constantly indicate that excessive oxidation is taking place, we must consider that it is among the *sub*-oxidation products or *structural antecedents of urea* that we may expect to find the characteristic toxin.

Finally, it will be instructive, in this connection, to ascertain whether or not the actions of remedial measures which have hitherto been found useful, will shed any light upon the subject.

This point may be disposed of very briefly, and as follows:

Every therapeutical measure that has attained a lasting place in the popular management of this disease has exerted its principal influence toward the induction of one or more of the following effects, viz.:

First, increased elimination, as by diuresis, diaphoresis, and purging.

Second, dilution of the body fluids, whereby the effect upon

the nerve centers of a toxin in the circulation would be lessened, as by increasing the amount of water ingested, milk diet, etc., and by bleeding, which secures practically the same result as far as the toxin is concerned, but in another way.

Third, as bearing more particularly upon the question of whether or not the toxin is a *sub*-oxidation product, lessening the amount of metabolic elaboration demanded of the trophic nerve centers, as by restriction of the diet.

Fourth, stimulation of metabolism, which, in this connection, means oxidation, by the administration of iron and other general tonics and the prescription of judiciously-regulated exercise.

Another fact bearing upon this point is the well-known evil effect upon the victims of Bright's disease of administering any agent which exhibits a tendency to check oxidation or metabolism, as alcohol, coal-tar derivatives, etc.

We find, then, that Bright's disease is a condition characterized by, and the clinical phenomena of which are probably due to severe systemic toxæmia of some sort, and that the toxin concerned is probably a sub-oxidation product which would normally be elaborated into urea. The occurrence of sub-oxidation means, of course, impaired metabolism, and impaired metabolism implies inefficient functionation of the sympathetic nerve centers, because it is under and through the control of these centers that metabolic processes are elaborated.

Therapeutic Indications.—The objects of treatment in Bright's disease, as indicated by the clinical phenomena and what is known of the pathology, would be, then, to secure

First, an increase in vigor in the functionation of the deep trophic nerve centers, impairment of which is probably responsible for the presence in the body of toxic products of imperfect metabolism.

Second, a direct increase of the oxidation processes in the body, whereby it will be possible to elaborate the chemical structure of the toxic bodies to a point which will admit of excretion without irritation; in other words, to oxidize them into urea.

Third, to secure as active an elimination as possible, in order that the system may be relieved of as much of the toxin as possible in the shortest possible time.

General Application.—Theoretically, this procedure should constitute an ideal therapeutical measure in connection with Bright's disease; it apparently satisfies all three of the indications for treatment.

Practically it does not prove to be as profoundly and uniformly curative as might be expected from its physiological action, but even under such limitations it is the most effective and satisfactory remedy now at our command, especially in acute cases and exacerbations of the chronic form.

In cases characterized by large amounts of albumin in the urine, and deficiency in the urea output, the former constituent lessens markedly soon after the treatment is inaugurated, and the latter is increased sometimes one hundred per cent. during the twenty-four hours succeeding the first application. In chronic cases, exhibiting a practically normal urea output, no increase in this excretion, and no very marked or immediate diminution in the quantity of albumin, may be apparent, but the evidences of toxæmia, such as headache, dizziness, etc., disappear rapidly. The patient is restored to usefulness and enabled to resume his daily occupation, even when the same involves pretty strenuous application, but albumin may persist in the urine for years. Some of these cases are restored to apparently perfect health.

ILLUSTRATIVE CASES.

Acute Albuminuric Nephritis.

Case I.

G. B., aged fifteen years, was brought to the sanitarium on April 6, 1904, by Dr. W. S. Randall, of Derby, Conn., at four o'clock P. M. The history of the case up to that time is quoted from a letter written me by Dr. Randall on November 9, 1904, as follows:

"I was called on February 11, 1904, to attend this boy, and found him with a high fever; forty-eight hours after a rash appeared and a diagnosis of scarlatina was made. He was given the treatment usual in such cases—tr. ferri. chlor., a

gargle for his pharyngitis, and kept in a warm room under the care of a nurse. A light and easily digested diet was ordered, and an antiseptic ointment applied to the body at intervals.

" All went well, fever subsiding and patient beginning to get about his room and take more food, until about March 6th, when œdema began to show itself about his feet and ankles. Urinalysis showed small percentage of albumin, the total quantity of urine passed being small in amount, and of high specific gravity.

" Diuretics and Basham's mixture were given, which seemed to relieve the early stages, but, as the case progressed, the œdema extended up the body, involving the thighs, hips, and scrotum. Dry cups over the kidneys and sweating were freely used, and some relief resulted apparently, but still the œdema persisted, and the patient seemed to make but little headway.

" Thus the case ran along, improving somewhat, until March 27th, when it was decided to move him to his home, he having been in a boarding house up to this time. A little cough had developed, and some shortness of breath was then present.

" After his removal in a close carriage, a distance of one and a half miles, he seemed rapidly to get worse. Dyspnœa and œdema increased, marked dullness developed over the lower chest wall, and abdomen became distended. The kidneys were getting into an intensely congested state, as was shown by the presence of a high percentage of blood in the urine.

" Diuretics, saline cathartics, and heart stimulants were freely administered, with only temporary relief.

" From this time the case grew steadily worse, until, on the 5th of April, I was suddenly called to his bedside to find him suffering from extreme dyspnœa, and in such an alarming condition generally that I did not expect him to live until the following morning. I administered an hypodermic of morphine and atropine, which temporarily relieved his paroxysm, and the following day after a hurried consultation over the telephone I took him to your sanitarium for dry hot air treatment."

When this patient was admitted to the sanitarium the following conditions obtained:

Marked prostration and urgent dyspnœa, which forced him to maintain an erect sitting posture and made speech a matter of considerable difficulty; patient was coughing constantly, lips were cracked and covered with large, bloody scabs.

His pulse was 124, weak, intermittent, and irregular, mouth temperature 99.2° F., respiration 52. The body was œdematous throughout, but especially so in the legs and feet, the last-mentioned members being about twice their natural size. Coarse

râles were diffused over both lungs and marked dullness, almost flatness, presented over their lower portions.

He was passing a small quantity of very dark brown urine of specific gravity 1001, which contained a large amount of albumin, some cylindroids and degenerated cells, a few hyaline and many granular casts, red blood cells, and small round cells from the renal tubules.

It was, in short, a typical case of dangerously severe acute nephritis, so severe that Dr. Randall "did not expect him to live until the following morning" the night previous; he afterwards told me that he was very doubtful as to his ability to get him to the sanitarium alive.

He was given a body dry hot air treatment at once; one-tenth of a grain of calomel combined with sodium carbonate was administered every half-hour until one grain had been ingested, one-sixtieth of a grain of strychnia sulphate every six hours, and one-eighth of a grain of morphine combined with atropine was given hypodermically three times during the night. His diet was cut down to milk and beef tea.

By the next morning a diminution of the dyspnœa, cough, and œdema was perceptible, and he had slept at intervals during the night a total of five and three-quarters hours, *propped up by pillows;* he felt and was appreciably improved. As the calomel had not acted, two drams of magnesium sulphate were ordered administered every two hours until the bowels moved. At 10 A. M. his pulse was 112, mouth temperature 99° F., respiration 36.

At 11 A. M. another general dry hot air application was administered; at 4 P. M. the bowels moved loosely and freely, and at 5 P. M. one-fortieth of a grain of strychnia sulphate was administered, the preceding dose having been given at midnight. The improvement in the symptoms noted in the morning had increased during the day, the patient now being able to *recline upon his bed* propped up by pillows. A noticeable decrease had also obtained in the dullness over the pulmonary areas and in the number of râles audible.

The urine passed during these first twenty-four hours measured two pints, of specific gravity 1001, color very dark brown with coffee-grounds sediment, and it contained a large amount of albumin, numerous casts and red blood cells.

To make a long story short, this patient was under treatment at Newhope *one week,* during which period he was given four general dry hot air treatments, three static induced electrical applications over and through the kidneys, and three static wave current applications to his spine. The *first* electrical treatment was given at noon of the *third* day, so that no part

of the very significant modifications of symptomatology noted during the period preceding can be in any degree attributed to electricity.

After the first twenty-four hours, the only medicine administered was one-sixtieth of a grain of strychnia sulphate every six hours and magnesium sulphate in two-dram doses every two hours, when it was necessary to move the bowels. One movement a day was all that it was attempted to produce.

The diet throughout consisted solely of milk, beef tea, chicken broth, a little rice, and a small piece of stale bread once daily. From a pint to a pint and a half of water was administered, in small quantities at a time, during the twenty-four hours.

The improvement, the inauguration of which is described above, steadily continued until he was discharged, when he went home to Derby, a distance of ten miles, on a trolley car, walking from the sanitarium to the cars a distance of half a block. The dyspnœa and cough had entirely disappeared, and, during the last three nights of his stay, he had slept *lying down* in bed; the œdema of the lungs and effusion into the pleural cavities had entirely disappeared, and the dropsy had vanished from all parts of the body except about his ankles and feet. He was as hungry as any healthy boy of his age could be, begging for something to eat with tears in his eyes.

The urine passed during the *second* twenty-four hours measured *three* pints, as contrasted with two pints during the like period of time preceding, of specific gravity *1009*, as contrasted with 1001, *two per cent.*, by volume, of albumin in place of the large amount contained in the preceding specimen, and a decided lessening in the quantity of blood and number of casts present.

That passed during the *third* twenty-four hours measured *eight* pints, exhibited a specific gravity of 1006, a trace of albumin *so small as not to be susceptible of exact determination* by the ordinary methods, and estimated at one-eighth of one per cent., and *no casts*. From this time until he was discharged the quantities passed during the successive periods of twenty-four hours varied from three to six pints, the specific gravity from 1006 to 1010, with a small trace of albumin and an occasional cast.

The progress of the case since leaving us is thus described by Dr. Randall, who thereafter had him in charge.

"After his return he was put upon a strict milk diet, given freely of water, and a tonic treatment administered. The static current was used twice a week over region of kidneys from April 30th to July 16th, 1904. The urine gradually

cleared from the blood cells and albumin, and the last examination on July 16th showed no trace of either. He has remained well ever since."

Although this case constitutes very good evidence as to the value of general dry hot air applications in acute Bright's disease, yet it by no means exhibits the almost magical changes that are sometimes producible in its symptomatology by the employment of this agent. The following is an instance in point:

Case II.

Mr. E. K., aged forty-eight years, was admitted to the sanitarium for treatment at noon, January 13, 1902. Three months previously he had begun to notice that his feet were swelling, that he was having occasional headaches, attacks of vertigo, and difficulty in breathing during exertion, but thought little of it, as he was very fleshy. The symptoms shortly increased to such an extent that he consulted a physician, who recognized the trouble, judging from his prescriptions, but did not inform the patient. He continued to grow rapidly worse under treatment, and soon after consulted another with a like absence of results as far as improvement was concerned.

Upon his admission his condition was one of great gravity. He had been unable to attend to his ordinary duties for three weeks. The subcutaneous tissues all over the body were greatly distended and fluid was present in the abdominal and pleural cavities.

Respiration was irregular, nearly impossible in the recumbent, and very difficult in the upright positions, and ranged from thirty-six to forty cycles per minute. Pulse small and wiry, irregular, and from 100 to 115 per minute. The least exertion brought on alarming acceleration and embarrassment of both respiratory and cardiac functions. Temperature 99.1° F. Patient was profoundly prostrated. Weight *325 pounds.* Height, five feet eleven inches.

He was passing urine with a specific gravity of 1002, which was loaded with albumin and casts. As the twenty-four hours' urine had not been collected previously to his admission, the total urea output for that period was not determinable, but as I was unable to convince myself that the quantity was excessive, the low specific gravity would indicate that it must have been considerably below the normal.

He was given a body dry hot air treatment at 4 P. M., during which he perspired as I had never seen a patient perspire be-

fore. By the time the treatment was concluded, his respiratory oppression had noticeably diminished, his pulse had increased to a marked degree in volume, and the irregularity which had previously characterized both functions was considerably less evident. The skin upon his legs and abdomen, which had previously been so tense as to threaten rupture, was *wrinkled,* the subcutaneous tissue could be felt as having softened in a marked degree, and he expressed surprise at the facility with which he could perform bodily movements, as compared with the painful stiffness and sense of distention which accompanied his efforts before the treatment.

That night he was able to sleep considerably *lying down,* and during the next twenty-four hours the following changes were observed:

First, the respiratory and cardiac embarrassment continued to decrease, the irregularity characterizing the latter function entirely disappearing.

Second, the dropsy rapidly diminished until by night it had entirely disappeared except in the legs, and the condition of these members was by no means formidable.

Third, he was resting comfortably and took his nourishment with enjoyment.

Fourth, he had perspired more or less continuously since the treatment, and had passed *four and a half litres* of urine, with a specific gravity of *1022* as compared with the *1002* exhibited by the specimen taken before treatment, which figure indicated that about four times the normal amount of urea had been excreted during this period.

Fifth, a decrease of about fifty per cent. in the quantity of albumin obtained.

Sixth, his weight was 280 1-2 pounds, as contrasted with 325 pounds on the previous day.

He received ten body dry hot air treatments during the next two weeks, at the end of which time he felt well enough to go home and to work, which he did, against my advice and judgment, however. During these two weeks he had improved steadily in all directions. The albumin in the urine continuously decreased, as did also the dropsy of the legs. The specific gravity of the urine ranged from 1004 to 1014, except after the body treatment, when it sometimes reached 1020 and over. The daily quantity of urine passed ranged from 2 to 4 1-2 litres. He began to go out for short walks after the first five days. During the last few days absolutely no dropsy was discernible in the morning, but it would appear to some extent in his legs at night, or after he had been out walking.

The other remedial measures, which were applied simultane-

ously with the dry hot air, were restriction of the diet to milk, junket, and cereals, for the first five days, after which eggs and milk toast were added; a grain and a half of calomel in divided doses three times during the two weeks; general static electrical applications, once daily; and during the last four days of his stay a gentian and iron tonic, which he was directed to continue after he left.

I saw this patient again a year later, and although he had suffered another exacerbation in the meantime under the care of another physician, yet he was then steadily and uninterruptedly pursuing his vocation of locomotive engineer. As long as he took proper care of himself, he experienced no disability, and although some albumin was still constantly present in his urine, no dropsy or indication of the disease other than the albumin was discoverable.

Chronic Albuminuric Nephritis.

Case III.

Mr. J. H., bookkeeper, aged thirty-three years, was referred to us for treatment by Dr. Albert C. Geyser, of New York, N. Y., and was admitted to the sanitarium at noon on March 30th, 1904.

The existence of chronic Bright's disease had been accidentally discovered four months previously through an examination for a life insurance policy, and during this period the ordinary medicinal, dietary, and hygienic treatment had been administered by one of the best and most widely-known of New York's physicians; there could, therefore, be no doubt as to the wisdom and good judgment with which the management of the case had been directed.

During this period there had been present, with a fair degree of constancy, aching pains in the loins, frequent attacks of dizziness, and some physical weakness and prostration, by reason of which he tired easily upon exertion. These symptoms interfered, more or less, with his comfort and the satisfactory performance of the duties of his vocation, and, as no improvement obtained under the ordinary remedial measures, he sought the advice of Dr. Geyser, who recognized at once the meager prospects of improvement offered by a continuance along the same old line under the circumstances, and recommended the application of dry hot air.

According to Dr. Geyser's letter of information, he was

passing, before his admission to the sanitarium, a good quantity of urine of specific gravity 1005 to 1010, which contained from *ten* to *twelve* per cent., by volume, of albumin and some granular casts.

His general condition when he entered was marked by considerable bodily weakness, frequent attacks of dizziness, sometimes two or three in a day, aching pain through the loins, and pronounced anæmia. No dropsy of any sort or degree was, or had been, in evidence.

He was put upon a diet consisting of one quart of milk per day, and more if he wanted it; one quart of water per day, and more if he wanted it; cereals and white meats, and later this was expanded to include red meats or fish once a day, the common vegetables and plain puddings.

During the five weeks of his stay at Newhope, he received ten body dry hot air applications, eleven applications of mechanical vibratory stimulation to the posterior spinal nerves, ten static wave applications localized over the spinal cord, and four localized over the kidneys posteriorly, five applications of the static induced current through the kidneys, nine general high frequency treatments administered by means of Piffard's auto-condensation cushion, and four applications of the continuous current to the entire length of the spine.

The medicines administered during the first two weeks consisted solely of magnesium sulphate in two-dram doses every two hours, when it was necessary to move the bowels; and this drug was continued p. r. n. during the whole of his stay. Alkalithia was then given in dram doses three times daily for four days, but was then abandoned because it seemed to induce some muscular weakness. One dram of the syrup of hydriodic acid and an iron and strychnia pill were then administered three times daily until his discharge.

Improvement in all directions commenced at once, and continued steadily but slowly throughout the course of treatment. During the last two weeks of his stay he had no pain in the loins, no dizziness, and his physical prostration had entirely disappeared.

The total quantity of urine passed during the twenty-four hours succeeding the first general dry hot air application measured six pints, exhibited a specific gravity of 1009, and contained a large amount of albumin (amount not quantitatively determined), granular and hyaline casts, and small round cells from the renal tubules.

That passed during the twenty-four hours ending April 11th, or two weeks after admission, measured seven and one half, pints, exhibited a specific gravity of 1009, and *two and one-half*

per cent., by volume, of albumin against the ten and twelve per cent. which obtained before treatment was commenced.

Although the specific gravities of the specimens remained the same as recorded above, yet the greater total quantity of the later specimen demonstrated that the excretion of urea was greater during the later period.

Thereafter, the total quantity passed during the twenty-four hour periods varied from six to seven pints, the specific gravity from 1009 to 1012, and the quantity of albumin from two and one half to four per cent. by volume. Casts and epithelial cells from the renal tubes were sometimes absent from the urine for more than twenty-four hours at a time; at such times the microscopical findings were almost absolutely negative in every particular.

A letter received from this patient on August 18, 1904, stated that he was still under treatment by Dr. Geyser, and announced his intention of visiting the sanitarium again (not for treatment, however), where he "was put back on the road to health and happiness."

Dr. Geyser wrote me under date of October 18, 1904, that the patient was "still under treatment with me, dietetic, hygienic, vibration, and electricity, each as indicated; no drugs. Urine still exhibits low specific gravity and contains the usual amount of albumin. Patient feels good, and follows his vocation as bookkeeper every day, appetite good, sleeps well, has no dizzy spells; is symptomatically very much improved."

These three cases illustrate very well the different phases and degrees of profundity, of the influence obtainable with dry hot air in this disease.

They all three exhibit in common its power to increase the total urinary and urea output in cases manifesting deficiency in these excretions, to decrease the quantity of albumin voided, and to relieve the headache, dyspnœa, and other evidences of toxæmia.

Cases I and II illustrate its influence upon acute dropsy, Case II, in particular, demonstrating the striking rapidity with which reduction is sometimes effected.

Case III exemplifies its effect upon many of the more chronic forms of the affection, wherein it does not produce entire disappearance of the albumin, or restoration of specific gravity to normal, but does restore the patient to unimpaired usefulness and apparent health which, as far as our present

knowledge goes, are susceptible of maintenance as long as good judgment and intelligent supervision are exercised in regulating his habits and mode of life, especially as regards the occasional administration of dry hot air treatments and dietary restriction.

Furthermore, it will be observed that each of the above-described results was obtained in spite of the fact that the patients were all under the treatment during a ridiculously short time in which to expect curative effects in an ailment exhibiting such intractability as characterizes true Bright's disease; Case I was treated for one week, Case II for two weeks, and Case III for five weeks.

Finally, that the results obtained are justly accreditable to dry hot air is evidenced by the fact that additional remedial measures, other than those which had already been and were being employed without benefit, were not combined with the thermal element until after these striking modifications of symptomatology had become manifest.

TREATMENT.

General Dry Hot Air Application.—The technique of its administration is very simple. The majority of these cases are encountered in persons whose arteries have not yet taken on atheromatous changes, hence particular care in this direction is not necessary. There is usually present, however, a high pulse tension, and, during the first treatment, the heat should be increased rather slowly, watching this phenomenon meanwhile. It usually lessens during, or immediately after, the first séance. If no undue exhaustion follows the first treatment, and it very rarely does, the application may be repeated the following day, and thereafter every second or third day.

The temperature of the first treatment should be at least 300° F., and in those succeeding it should be pushed to 350° or 400° F., and run up as quickly as the patient's tolerance will permit. By this technique is secured a sudden strong impulse upon the nerve centers, which it is our aim to influence as profoundly as possible.

The after-care of the patient is that usual to the body treatment.

I have not yet treated, and I have not heard of anyone else having treated, a case of complete uræmic coma with dry hot air. It is reasonable to suppose, however, that it would act as efficiently in this condition as in the milder forms of intoxication, and if this proves to be true it will have forged another great claim upon our respect.

Additional Remedial Measures.

Diet.—The diet should always be cut down to milk, and milk only, if possible, until the toxæmia has been gotten thoroughly under control, and should then be regulated according to the conditions obtaining in the individual case. The more water the patient drinks the better, and no fear need be entertained that it will increase any dropsy that may be present; the tendency is entirely in the reverse direction.

Clothing.—Woolen undergarments of light weight in summer, and heavier in winter, should be worn at all times by the victims of this disease. Chilling the surface of the body interferes with the emunctory functions of the skin and may exercise an evil influence, directly or indirectly, upon structures in the interior of the body whose functions are concerned in metabolism.

Drugs.—The bowels should be kept freely open by the use of calomel and salines when any inclination towards constipation is evident, and digestive disturbances should be corrected, but aside from this drugs are very rarely necessary except as tonics, when dry hot air is being administered, and the less medicine the patient ingests the better usually.

Electricity.—Next in importance to general applications of dry hot air may be placed the static, static derived, and high frequency electrical currents, especially in the chronic forms of the disease. Gratifying reports of the efficiency of these modalities have been made by Neiswanger, of Chicago; Reed, of Philadelphia; and others in this country and Europe, and the writer takes pleasure in adding to their statements an expression of his belief in the good that may be accomplished by their administration, especially the static wave and the static induced currents. He does not, however, believe it justifiable to rely

upon them or any other one remedial agent to the exclusion of others that promise to influence the disease process happily. He believes that much quicker and better results can be obtained by combining several means of benefit than by the use of any one alone, and in a disease of such gravity and general intractability it is certainly wise to give the patient the benefit of everything known to be helpful in bringing about the restoration of health.

The remarks in the section upon "Intermissions in Treatment" in the chapter on "Technique," apply with some force to the management of this disease. It will usually be found advantageous to treat the patient steadily for five or six weeks at first. The time duration of subsequent courses, and of the intervals between them, will be governed by the effect produced in the individual cases.

In concluding this subject, it will not be amiss to call attention to the fact that "Eternal vigilance is the price of safety." While many patients are apparently cured by the use of the above-described remedial measures, yet the majority are merely improved to such an extent that by the conscientious exercise of unremitting care they may live for years in good health and practically unimpaired usefulness; a little neglect as regards diet, exposures, or over-exertion, however, is sometimes sufficient to bring on an exacerbation, and force the patient to undergo another course of active treatment. There are few diseases in which an eternal exercise of caution and judgment are so necessary to the continuance of the victim's life, health, and comfort, as in the one which we have just been considering.

CHAPTER IX.

ARTHRITIS DEFORMANS.

Modifications of Clinical Conditions producible with Dry Hot Air.

Local Application.

This measure sometimes exhibits considerable efficacy as a pain-relieving agent, and in rare cases appears to exercise some positively curative influence; as a rule, however, it does not enter largely into the management of the disease.

General Application.

First, temporary mitigation of pain frequently and a sedative influence upon the nervous system, which increases the amount of sleep and quietude procurable, hence conduces to invigoration of the nerve centers.

Second, increased oxidation of waste material and acceleration of the process of its elimination through the skin, lungs, and kidneys, thereby relieving the already depressed nervous functions from the further depression which would be induced by the retention of sub-oxidation products in the body.

Third, an influence upon the nervous system as a whole and upon general metabolism, which is in the line of a stimulation of physiological repair and normal function, hence is not followed by evil reactionary effects when judiciously administered, and results in a hastening of the process of recovery of impaired structures.

Fourth, the restoration to usefulness and comfort of a large proportion of the victims of this disease, who, without it, would be doomed to a painful life of hopeless and helpless crippledom.

RATIONALE OF THERMOTHERAPY.

It has always been our contention that if dry hot air did nothing but relieve the agonizing pain of acute rheumatism,

it would be entitled to a place in the highest rank of therapeutical agents. We have seen that it not only does this, but that it lessens, by a large percentage, the duration of the disease, and transforms rheumatism from one of the most obstinate into one of the most tractable of ailments. In arthritis deformans we are again struck by the claim which it imposes upon our respect, because of the power which it exhibits of rendering useful and comfortable many lives which would otherwise be spent in hopeless and helpless misery. This disease has been hitherto, and is now, under ordinary management, the *bête noire* of the profession.

The correct diagnosis of this ailment, from a therapeutical standpoint, is of the utmost importance, because it is one of those affections in which the treatment of conditions closely resembling it clinically is usually ineffective and sometimes positively harmful. If the victims of arthritis deformans are brought under an appropriate line of management at a moderately early stage, the great majority of them can be restored to useful and comfortable lives, and a large proportion can be restored to apparently perfect health, whereas, if the disease is unrecognized, hence improperly treated for months or years, organic changes will take place in the structures involved of such a nature and degree as will render utterly impossible the restoration of normal function. Because of these facts, I shall touch briefly upon some aspects of the problem that do not come strictly within the scope of this work.

Etiology and Pathology.

Nothing conclusive can be said as to the primary etiology of this disease; some observers believe a micro-organism to be responsible; others that it is a disorder of general metabolism; and still others that it is some disorder of the central or sympathetic nervous systems whereby the trophic functions of the nerves supplying the parts affected, or of the centers controlling these nerves, are impaired. Those maintaining the last-named hypothesis seem to be in the majority at present.

Neural Theory.—Among the most prominent reasons for

considering it to be of neural origin may be mentioned the following:

First, its most constant lesions, viz., dystrophy of the joint cartilages and articular portions of the bones, the pigmentation and textural changes in the skin, and the atrophy of the muscles controlling the affected joints, are all of a tropho-neurotic character.

Second, it rarely, if ever, occurs in an individual who is not of a neurotic tendency, or debilitated by some excessive nerve strain or depressing illness, as la grippe, typhoid fever, nervous exhaustion, etc., or constitutionally weakened by some diathesis (tuberculous, lithæmic, or otherwise).

Third, lesions, at least of the joints, anatomically identical with those encountered here, are also met with in some degenerative diseases of the spinal nerve tracts—as tabes, for instance.

Fourth, the joint lesions usually occur more or less symmetrically on both sides of the body.

Fifth, local measures exclusively, very rarely accomplish anything but temporary relief of pain, while measures addressed to the nerve centers themselves accomplish a great deal in the way of permanent cure.

Sixth, the disease is nearly always accompanied by marked evidences of impairment of function of the sympathetic nerve centers, for the explanation of which the presence of pain and its direct or remote effects, in the localities and of the nature and severity of that accompanying arthritis deformans, is not always sufficient.

Another fact which may be looked upon as possessing some significance in this connection is that in some cases the improvement under treatment in the general condition will be marked, but the local lesions will show no signs of permanent gain for several weeks. This might be due to the fact that the local lesions are dependent upon trophic impairment of the central nervous system, and that they will not improve until these centers, which control their nutrition, have been brought to a state of efficient action. While this result was being obtained, the local lesions would be expected to remain in *statu quo*.

It must be admitted that much of the available evidence points strongly to the conclusion that the disease is not primarily local.

Rheumatism as a Causative Factor.—It is not at all probable that the disease is "rheumatic" in its nature, although an acute attack of rheumatism in one whose nervous system is predisposed may precipitate the disease. We have personally had several such cases under observation. When such a case is encountered before the active rheumatic influence has subsided, and if the trophic functions have not been too much impaired to recover their equilibrium upon removal of the exciting cause, anti-rheumatic treatment will frequently cure the arthritis deformans by removing the rheumatism which had set up and was keeping up the trouble. If the predisposition to the disease is constituted by the lithæmic or gouty diathesis, as I believe it occasionally is, then iodide of potassium, colchicum, or other drugs of a like nature will always benefit, and sometimes cure, the affection. But when the disease is not dependent upon, or precipitated by, a pathological condition amenable to what we look upon as specific medication, nothing benefits it in the least except measures directed towards improvement of the general metabolic functions and anti-rheumatic or anti-lithæmic remedies sometimes cause an increase in the intensity of the symptoms.

"Uric acid" may be ruled out absolutely as a causative factor. Its presence or absence, excess or deficiency, have nothing whatever to do with this problem.

If it is a disorder of general metabolism, or of the sympathetic nervous system, then it follows that all nerve debilities—neurasthenia, hysteria, etc.—are not necessarily so devoid of evil tendencies as has been generally believed, and that thorough and efficient treatment of the same should be instituted as soon as they come under observation, and persevered in until they are removed. It is probable that, when this plan of dealing with the so-called functional disturbances of the nervous system is uniformly adopted, we shall encounter arthritis deformans and some other grave constitutional diseases less frequently.

Symptomatology.

The most important symptomatic phenomena accompanying the disease are as follow:

First, pain.

Second, elevation of body temperature.

Third, general nervous debility.

Fourth, atrophy of the musculature controlling the affected joints.

Fifth, spasm of these muscles.

Sixth, textural changes in the skin.

Seventh, pigmentation of the skin.

Eighth, a slight degree of albuminuria.

Ninth, a varying degree of general systemic toxæmia.

Pain.—The pain is of two varieties; that in the joint itself ordinarily described by the patient as "boring," "grinding," or "aching" in character when the joint is at rest, and as an excruciating "soreness" when the member is manipulated; and that in the nerve trunks from which the joint and its musculature are innervated.

The first mentioned is usually constantly present in the acute stage. At any stage it is increased by movement, or by sharply bringing the affected articular surfaces together, as by tapping sharply and suddenly the bottom of the heel of the extended leg when the hip is affected. Palpation of the affected joint provokes pain, and the firmer the pressure the greater the pain induced. Occasionally a case is encountered, especially in old patients, wherein no pain of any sort is present while the affected member is at rest, but it is always provoked by motion.

The pain in the nerve trunks is paroxysmal, nearly always worse at night, and there is usually present in acute cases a constant, dull, aching soreness. A certain proportion of the aching soreness is probably due to pressure upon the nerve trunks from tonic spasm, which is frequently present in the muscles controlling affected joints. Portions of the nerve are usually sensitive to pressure, as in ordinary neuralgias.

A characteristic feature of the pain when the hip joint is

involved is that it appears in the groin as well as in the hip. This peculiarity is very common in arthritis deformans, and very rare in most other affections of this joint, from which it would have to be differentiated.

Another characteristic sign when the hip is involved is inability to cross the leg on the affected side over the opposite knee, when in the sitting posture, without lifting the member with the hand. This phenomenon is dependent largely, if not entirely, upon reflex inhibition of muscle function due to the progressively increasing pain caused by this particular movement of the joint.

Body Temperature.—The elevation of temperature varies from half a degree to two degrees Fahrenheit above the normal, very rarely more, and presents a very constant general curve, being below normal in the morning, beginning to rise about eleven or twelve o'clock, and reaching its maximum in the early evening. In severe, acute cases, especially in young patients, it sometimes reaches 102.5° F., but we have never seen an uncomplicated case in which it went above that point.

It will be observed that this resembles the temperature curve characteristic of some other diseases, notably tuberculosis, and it is not always the easiest thing in the world to differentiate mono-articular arthritis deformans from joint tuberculosis at the first visit. As a rule, however, the temperature of tuberculosis runs higher than that of arthritis deformans, its curve is more irregular, and it reaches its maximum elevation earlier in the day. In doubtful cases the development of other characteristic signs will soon settle the question.

Nervous System.—The nervous debility does not differ from that due to other causes, except in its profoundly trophic character, and can always be demonstrated as having preceded by some weeks or months the development of the characteristic symptom complex. The tendon reflexes are somewhat increased usually; the secretions of the digestive ferment-producing glands are impaired, and departures from the normal, both gastric and intestinal, are in evidence. Sleeplessness, sometimes from pain, but also sometimes from pure irritability of the cerebral centers, is occasionally a troublesome symptom.

As a rule, however, patients nap sufficiently during the day to make up for what they lose during the night.

Muscular Atrophy.—Atrophy of the muscles controlling the joint is a very constant phenomenon, and is usually accompanied by tenderness of the same upon pressure, as in pinching. Impairment of function is present in variable degree, which, in many cases, presents a characteristic also met with in rheumatism, viz., the muscles can be contracted up to a certain point, when further movement ceases sharply and suddenly as if the joint were hung on a ratchet. In other cases it consists of simple weakness, and in still others of a reflex inhibition of function from the pain in the joint which movement excites.

Muscular Spasm.—A frequent cause of pain in cases where the larger joints are affected is spasm of the controlling musculature occurring during sleep. As soon as the patient relaxes into sound slumber he is awakened by excruciating pain, and finds the affected muscles strongly contracted. This condition is sometimes sufficiently persistent to prevent securing the necessary amount of sleep, and the victim becomes so fearful of the agony of the awakening that he is afraid to attempt it.

When the cervical vertebræ are involved, profound, persistent, and very painful torticollis may be produced, and sometimes this condition may remain for years after all other signs of the disease have disappeared.

When the maxillary articulation is affected masseteric spasm is frequently a very troublesome factor; I once had a patient affected with such a lockjaw, whom I was obliged to feed upon liquids only, through his teeth, for two weeks. More or less limitation of the masticatory movements is always present when this joint is affected. Involvement of this joint, by the way, is a very characteristic phenomenon in this disease; it occurs with the utmost rarity in other diseases from which it might be necessary to differentiate arthritis deformans.

Persistent muscular contractures, such as accompany cerebral paralysis, are present in many cases exhibiting severe acute features, and in most of the old chronic cases.

Skin.—The textural changes sometimes resemble the "glossy

skin" seen in many cases of impairment of the function of peripheral nerves; sometimes the affected area does not exhibit any difference in color from that of the normal integument, but it has a peculiar dry, smooth, soft look and feel, like satin.

Cases are also met with in which the skin about the lesions, and sometimes over the whole body, looks and feels greasy and is covered with perspiration almost constantly; which condition is also encountered in other tropho-neuroses.

The characteristic pigmentation of the skin occurs as maculæ, varying in size from that of the head of a pin to that of a quarter of a dollar, the small sizes predominating. They are irregular as to outline and resemble the freckles seen upon elderly people, or "liver spots," more than anything else. They differ from these, however, in possessing a characteristic yellowish-brown, dirty look, which is usually distinguishable to an experienced observer, and also in that they are not confined to those parts of the body which are habitually exposed to the light, as is the case with true freckles. They usually are most in evidence on those portions of the skin contiguous to the affected joints, but may frequently be found also upon remote parts of the body, particularly the back, abdomen, extensor surfaces of the limbs, and about the clavicular regions.

We have rarely failed to find this peculiar pigmentation present to some extent in this disease, and although it is frequently present in individuals who are not so afflicted, yet we have come to regard it, when taken in connection with other symptoms, as one of the most valuable of the differential signs.

Albuminuria.—The urine of arthritis deformans very frequently contains a trace of albumin, probably due to renal irritation from excretion of products of faulty metabolism as it usually rapidly disappears under body dry hot air treatments.

We have never observed casts in uncomplicated cases.

Joint Appearances.—Nothing has been said about the external appearances of affected joints, because they do not possess any value as differential signs in those cases where differential signs are most needed. One or more may be involved, the swelling may be diffuse or nodular, the skin over

them may be shiny or dull, red, or devoid of any indication of inflammatory action. We have simply a pathological joint, any of the appearances of which may be duplicated by several other affections, and when these other affections enter the diagnostic problem it is invariably necessary to go outside of the external appearances of the joint for the decisive information. The same statement as to external appearances applies to the persistent muscular contractures.

DIAGNOSIS.

Symptomatology.—At the present time, unfortunately, this disease is more frequently overlooked and miscalled than probably any other to which flesh is heir. This is due to the fact that it has only very recently been recognized as a distinct disease entity, which has prevented the constant and characteristic symptoms from being studied and grouped so as to make it recognizable by physicians at large, and to the additional fact that it has hitherto been almost absolutely intractable to all known treatment, which has discouraged attempts at differentiation because of the apparent uselessness of the result, if attained. The therapeutical development of dry hot air and static electricity, however, has changed these conditions, and rendered the attainment of an early diagnosis of the utmost importance to the patient.

It will be observed from the foregoing that the more prominent conditions from which arthritis deformans is to be differentiated are acute and chronic rheumatism; chronic synovitis; flat-foot; chronic gouty conditions; neuritis; sometimes tubercular and syphilitic joint lesions; and when symptoms are encountered pointing to the spinal column or hip joints as affected by a disease process, tumors in the thoracic, abdominal, or pelvic cavities, so situated as to involve the nerve trunks and plexuses in these regions.

When the symptom complex is complete and well developed little difficulty is experienced by those who have seen much of the disease, but it not infrequently exhibits a reluctance to so betray itself, especially in the early stages of the attack.

There are two conditions met with in early cases, which may

be looked upon as almost positively characteristic when occurring in connection with acute inflammatory joint conditions, viz., involvement of the maxillary articulation, and a greater or less degree of persistent torticollis; these phenomena occur with the greatest rarity in other conditions from which it might be necessary to differentiate arthritis deformans.

A history of repeated attacks is of considerable significance.

If the joint involved is the hip, reflection of the pain into the groin, exacerbation of the pain by pressing inward upon the trochanter, or by sharply tapping the bottom of the heel of the extended leg, and inability to cross the leg upon the affected side over the opposite knee, when in the sitting position, without lifting the member with the hand, form a combination of symptoms which is practically conclusive, in the absence of well-known clinical signs of the other resembling conditions, and this combination is almost invariably present in arthritis deformans of this joint.

After an attack has existed for some weeks the characteristic muscular contractions and atrophy, glossy skin, and other signs previously mentioned, combine to form a picture which is hardly mistakable for anything else.

The Roentgen Ray.—X-light is a very useful diagnostic agent in doubtful cases of some standing. By it can be determined absence of cartilages which have been absorbed, a characteristic lesion of the disease when taken in connection with other symptoms and by reason of which the bony surfaces are closely approximated; a very different picture from that which obtains in healthy joints (Cuts XXIV, XXV, and XXVI). Osteophytes, when present, are observable by this means, and bony anchylosis is usually differentiable from the fibrous variety, except when the hip or the vertebræ are in question; even then its answer is sometimes conclusive.

Occasionally it is only by a process of careful exclusion and the closest scrutiny of the history of the case that a correct diagnosis can be reached. It can be reached, however, positively, satisfactorily, and at once, in nine cases out of ten, and no pains should be spared to secure this end, in view of the

XXIV.—Changes in Joint Structures Produced by Arthritis Deformans of the Fingers.

XXV.—Normal Finger Joints (a Fragment of a Needle Appears Imbedded in the Middle Finger Opposite the Third Phalanx).

fact that the disease is no longer to be classed with those that are not amenable to treatment.

Inconstancy of Symptom Complex.—We will close this brief section upon the exceedingly important problem of diagnosis by calling attention to the following additional facts which bear upon this point.

Although in the commonest form of the disease, which occurs almost exclusively in patients over forty, the small joints are

XXVI.—Arthritis Deformans of the Knee (from a radiographic standpoint the position of the joint is faulty, but the plate illustrates very well absorption of the joint cartilage; in radiographs of the normal knee the presence of these cartilages causes a large clear space to intervene between the patella and the articular surface of the femur anteriorly; in advanced arthritis deformans of this joint the patella appears to rest directly upon the femur as above shown).

first attacked, and the lesions are nearly always bilateral, yet this is not necessarily the case in all forms of the trouble. An attack may commence in the larger joints, run its course, and

recover without having involved the smaller joints at all; or it may be confined entirely to one large joint, as the hip for instance. Some of the severest cases are of this character.

While the onset is usually gradual, with a beginning so insidious that the patient is not aware that anything is wrong until a wrench calls his attention to the sensitive member, yet it may develop as suddenly as acute articular rheumatism, and lay the patient helpless upon his bed in a night.

When the disease attacks a person under thirty years of age, it usually involves both large and small articulations, and in these cases the worse phases of the disease and those most resistant to treatment are encountered.

Therapeutic Indications.—The objects of treatment deducible from the foregoing would be as follow:

First, to relieve pain.

Second, to increase the efficiency of the trophic functions, and maintain the general nervous system of the patient in as good a condition as possible.

Third, to clear the system of sub-oxidation products.

Fourth, to relieve joint disability.

Local Application.—As this disease is not of local origin it would hardly be expected that this measure would exercise any positively curative power in uncomplicated cases, and our personal experience with it has led us to conclude that this inference is correct. I have never seen but one case in which curative effects could justly be attributed to it, and it was ultimately necessary to call upon the body treatment in this case before it could be brought to a successful termination.

Its power to relieve local stasis of the body fluids and to effect sedation of nerve tissue sometimes causes it to be very useful as a pain-relieving agent, and occasionally it performs this function better than anything else. Its possible efficiency in any given case can be ascertained only by trial.

General Application.—In our opinion, the body dry hot air application is to-day the sheet anchor of hope in the management of arthritis deformans, because through it is obtainable in largest degree the stimulant influence upon the trophic nerve centers and general metabolism which constitute the curative

element. Its physiological action, as will be recalled, may be summarized as follows: first, it produces an immediate and powerful stimulation of the vital physical signs; second, a reflex stimulation of the functions of all the organs and tissues of the body, resulting in, first, a degree of elimination of urea and other excreta which is probably unequaled by that producible with any other measure now known, and second, an amount of reconstructive activity which would appear also to be in excess of that derivable from the use of other agents.

Ample logical indication for its employment is found when we consider these influences in connection with the therapeutic indications noted above. There is usually present, first, a notable depression of the vital physical phenomena; second, impairment of function of many of the organs concerned in the digestive, elaborative, and assimilative processes of the body; and third, a marked deficiency in the reconstructive activities; the inferences suggested by the foregoing have been fairly well borne out by practical results accruing in actual experience.

ILLUSTRATIVE CASES.

That form of the disease which affects the smaller joints is common enough and familiar enough not to require illustration, but the following case exemplifies very well the variety which involves the larger joints, as regards clinical characteristics and response to treatment with dry hot air.

Mrs. E. L. P., aged sixty-two years, consulted me on May 14, 1900. She had noticed a soreness coming on after walking, just below the crest of the right ilium, four months previously, which soreness had grown rapidly worse for two months, by which time it had extended so that it involved the front and inner aspects of the thigh as far down as the knee. It had continued to increase, both as to severity and extent of area involved, until at the time of her consultation with me the pain was present in the hip, groin, and front and inner aspects of the thigh, and streaked down below the heel along the posterior aspect of the leg; her condition as regards pain and ability to move about was pitiable in the extreme. Was sleeping very poorly because of pain and muscular spasm in her thigh which awakened her frequently during the night. Suffered fre-

quently from hot flashes and formications irregularly distributed over the body. Appetite was fair and bowels regular.

She was markedly neurasthenic, and had been so since passing the climacteric twenty years previously. At this time she had also suffered quite severely from asthma, but this had disappeared after a stay in another city, and had never returned. There was no history of injury. Mouth temperature had ranged from 97° F., in the morning, to 99.6° F., at night. The extensor muscles of the thigh on the affected side had been somewhat stiff and sore upon pressure for the preceding ten months, but she had not paid much attention to the matter until the acute and constant pain had drawn her attention to the development of the disability. Had been treated for rheumatism up to this time, but without beneficial results.

Her mother had died of consumption, and maternal grandfather was supposed to have died from it. She was one of a family of eleven brothers and sisters, seven of whom were dead, and their health histories and the causes of death were negative as far as indicating hereditary taint was concerned. Father had died of dysentery at the age of seventy-three years.

Physical examination showed that the arcus senilis was well developed and that her radial arteries were atheromatous, but the heart sounds did not exhibit any abnormality and the lungs were sound. There were no evidences of past or present disease in the small joints, and no tenderness was present. She was unable to cross the right leg over the left knee without lifting it with her hand. Patellar reflexes were slightly increased, especially on the affected side.

The characteristic pigmentation of the skin was present on the upper and outer aspects of the affected thigh and on the abdomen. Sensory phenomena in the skin covering the affected thigh and leg were normal. Passively moving the hip joint caused only a feeling of soreness, but smartly tapping the bottom of the right heel with the leg extended caused the patient to cry out, and firmly pressing the head of the femur inward against the acetabulum, or tapping it smartly, produced the same result. The sciatic nerve was sensitive to pressure back of the trochanter, but nowhere else, and deep pressure in the groin just outside of Poupart's ligament elicited pain. Her urine contained a trace of albumin, but no casts.

It will be noticed that the characteristic signs of arthritis deformans of the hip joint were present, viz., inability to cross the affected limb over the opposite one unaided, while in a sitting position; pain in the hip reflected into the groin; pain upon pressing the head of the femur sharply and firmly against the acetabulum; the characteristic pigment spots in the skin,

and the typical slight elevation of temperature with a regular course. The diagnosis lay between pelvic neoplasm involving the sacral plexus or its branches, which was ruled out by physical examination and the clinical signs; sciatic neuritis, which was excluded by the absence of sensory disturbances in the distribution of the nerve, and the fact that stretching it by flexing the thigh upon the body did not produce pain until the hip joint began to be strained; and tuberculosis of the joint. The decided localization of the intensity of the pain in the hip joint, together with the characteristic symptoms noted above, were amply sufficient for decision in favor of mon-articular arthritis deformans, and I made this diagnosis.

She was admitted to the sanitarium for treatment May 15, 1900, four months after the acute trouble started. She was treated with the current from the high tension coil through the joint that evening, with resulting marked remission of pain, but she did not sleep well because of nervous irritability and muscular spasms in the affected thigh, which awakened her several times. The next day she was given a body dry hot air treatment, which did away with the pain entirely while she was in the apparatus, but it returned sharply an hour afterward. This was repeated every day the first week, and every other day the second week. Local dry hot air treatments failed to relieve the pain effectually, so they were abandoned and the current from the high-tension coil, which performed this office better than anything else, was substituted at least once, and sometimes twice, daily.

During the night of May 18th, she slept uninterruptedly all night, something she had not done before in many weeks, and she continued to sleep very well thereafter. The next day it was noticed that her limp was diminishing. On May 21st it was observed that the arteries at the wrist were growing softer and more elastic, and, to dispose of this matter for good, I will say here that when she was discharged at the end of three months, I was unable to observe that any atheroma was left. Finally, in this connection, I will state that a large number of cases of atheroma, at least in vessels susceptible of palpation, respond to body dry hot air treatments in this manner. It is not usual for the condition to disappear so entirely, however.

At the end of two weeks she was so far improved that she would be free from pain for twenty-four hours at a time, and could walk a short distance without bringing on a limp. If she continued walking, however, it would provoke the old soreness.

I decided to transfer her to the list of out-patients, and she

returned to the sanitarium for treatment three times weekly thereafter until August 3, 1900, when I discharged her cured. At this time she had suffered no pain of any description for two weeks. Her progress on the whole had been fairly steady, but there would be periods of two or three days at a time when her pain and disability would return upon her, as is usually the case with these patients. They rarely continue improving steadily from day to day, but have short periods of improvement, followed by periods of retrogression, but each period of improvement reaches a little higher level than its predecessor, until the trouble finally fades gradually and entirely away.

I next heard from this patient on February 18, 1901, when she called upon me one afternoon and said that she had felt none of the previous trouble, until about six weeks before, when she had suffered from a severe attack of la grippe. This had been followed by the old familiar pain, which was increasing in intensity, but not in the same place. It now involved the left hip and right elbow, and pigmentation of the skin was present in these regions and about the clavicles.

As the initiation of the process was so recent, and she was able to be about, I put her upon the out-patient list, and she came to the sanitarium for a body treatment, followed by some static modality, three times weekly for the next two months. The treatments were then reduced in frequency to once a week for two months more, when she was discharged cured. The drugs given were the chloride of gold and sodium, arsenic, strychnia, and occasionally a short course of bismuth subnitrate and peptenzyme for slight attacks of indigestion. I have kept track of her ever since, and she has not only had no pain or other evidence of her old trouble since her last visit to the sanitarium, but she has never felt better in her life than she has since then.

This case is instructive in several ways.

First, it is an example of pure, uncomplicated arthritis deformans in its very early stages, and exhibits a beautifully typical symptom complex of the affection when it occurs in the hip joint.

Second, it shows the futility of anti-rheumatic treatment in uncomplicated cases of the disease.

Third, it illustrates during the first attack the power of the body dry hot air application *alone* in controlling the disease, as the faradism used acted only, and was intended only, as a sedative.

Fourth, it exemplifies the power of the body dry hot air treatment in lessening, and sometimes apparently removing entirely, atheroma at least of the palpable arterial system.

Fifth, it is an example of the influence of acute infectious disease in precipitating a relapse.

Sixth, it exhibits the influence of the current from the high tension coil in temporarily alleviating the pains of the disease when other means are inefficient. Usually the static current is the most effective for this purpose, but, as has been previously stated, faradism or the high frequency current gives better results in rare cases.

There is a tendency at the present time to attempt a division of cases of arthritis deformans into two classes; those exhibiting atrophy of the joint structures, and those exhibiting hypertrophy, as exostoses, etc. This attempt has apparently been engendered by the thought that these two types, if they could be proved to exist, might be differentiable etiologically. The cases that have so far come under our observation have not led us to believe that such a classification is practicable; many of them exhibit the typical atrophy in some joints and the typical hypertrophy in others during the same attack. The following is a case in point:

The patient, a telegraph operator, thirty years old, came under our care for an acute attack of the disease in his shoulders, wrists, fingers, knees, and ankles. Twelve years before, when eighteen years old, he had been confined to his bed for several months by the same trouble in his hips, ankles, and toes, from which attack he had recovered.

At the time he came under our charge his toe joints presented the characteristic atrophic deformities much exaggerated, and the pathology of the lesions was interestingly verified later, when he had the little toe of each foot amputated at the metatarso-phalangeal articulation, because these members in their deformed condition interfered with the wearing of shoes. The articular ends of both the phalanx and the metatarsal bone forming this joint were found at the operation to have been absorbed for a distance of one quarter of an inch upon each bone, which accounted for his absolute inability to control the motion of his toes.

The point of greatest interest in this connection, however, lies in the fact that both of his hips had been *completely anchy-*

losed by the first attack; this fact could only be accounted for upon the hypothesis that the so-called hypertrophic form of the disease had disabled these joints, or that true bony anchylosis had supervened, and true bony anchylosis is said never to develop in this affection.

This patient was under treatment eight months before the disease was extinguished from those joints which were acutely involved when he came to us, and no change, of course, took place in the original seats of the process.

TREATMENT.

It is only within a very few years that systematic efforts to evolve a special therapy for this disease have been attempted, largely because, as already stated, it has been only a few years since our knowledge of the affection has been sufficient to render possible a positive diagnostic differentiation in a large proportion of cases. For this reason text-book literature upon its therapeutics is meager and very unsatisfactory when subjected to the test of clinical application, about all that can be gleaned from it being a recommendation to give the patient cod liver oil, iron, or potassium iodide for long periods, to maintain his health in as good condition as possible, and to send him to some hot springs or other health resort. As the belief that in it we have a distinct disease process exhibiting a characteristic symptom complex has gained ground, however, investigation has been directed more and more toward ascertaining what therapeutic measures are logically indicated by its clinical phenomena, and in what degree such deductions as to therapy are confirmed by the actual application of these measures. As a result, evidence is accumulating which indicates that modern therapy is capable of producing curative results in many cases, and marked amelioration of the symptomatology in a large majority of them; that arthritis deformans is about to be rescued from the category of hopelessly incurable diseases.

We may preface our consideration of the subject of treatment by the flat statement that any measure or remedy that tends, inherently or indirectly, toward repeated or sustained depression of the vitality of the individual is to be unqualifiedly prohibited.

Local Dry Hot Air Application.—As has already been in-

timated, this measure does not constitute an important element in the management of this disease. As it is sometimes fairly efficient in relieving pain, it should always be given a tentative trial when this symptom is troublesome. The technique is that usual to the treatment.

General Dry Hot Air Application.—The temperature should usually not be less than 350° F; as atheromatous arteries are commonly met with in these patients, it may be necessary to give less heat during the first two or three treatments until the arteries have softened some, but 350° F. can be attained safely afterward. The guide is found in the circulatory phenomena, as described in the chapter on "Technique."

Sometimes the first treatment cannot last more than fifteen minutes, and the requisite rise in temperature and pulse cannot be attained, but, as the arteries begin to regain their elasticity the response is more and more kindly, until finally the proper amount of influence upon the nerve centers can be induced.

The toes of patients with this disease seem particularly liable to suffer from the heat during the treatment, I presume because of inefficiency in the blood circulation, and if the apparatus is not so constructed as to permit of the feet being excluded from its interior, it will frequently be found necessary to bring into play all the maneuvers described in the chapter on "Technique" for the relief of the condition.

Efficient treatment of these cases will frequently take an hour, but the degree of response which means efficiency must be reached or the patient will not get his due in the way of benefit. The mere induction of perspiration, however profuse, as has been stated on a previous page, does not mean that the treatment has been properly completed. The requisite rise in temperature and pulse-rate does.

In this disease, again, it is particularly necessary to apply the higher degrees of treatment intensity and to run the heat up quickly, so as to secure the necessary degree of physiological influence as rapidly as possible. By this method we secure a profound stimulation of physiological function, which is what we desire to effect, whereas, if the patient is treated for long periods with the lower degrees of heat, the ultimate result is

likely to be relaxing, depressing, and pernicious. The distinctions drawn between the effects of the different methods of applying heat and dry hot air body treatments in the chapter on " Physiological Action " apply with force in connection with this disease.

Additional Remedial Measures.

Electricity.

The next most useful of the physiological agents is electricity, and the several forms of current have distinct and different spheres of influence. The one of greatest utility is that derived from the static machine, and the wave current and the spark are the most frequently serviceable modalities. Some authors claim to have cured cases with the static current alone, but such an instance has never come within our personal experience, and it is usually difficult enough to benefit these patients materially when all the resources at our command are brought into action.

The Static Current.—During the acute stage the wave current may be applied to the affected joints twice daily by means of sheet tin electrodes molded to the parts, and this modality is frequently very effective in relieving pain. The influence of every static application is general as well as local, no matter how the treatment is localized, and the effect upon the organism at large is often happy to a degree.

The brush discharge from the wooden or carbon electrode applied to the affected part for fifteen or twenty minutes, is effective in relieving the neuralgias as well as the aching pains of the acute condition, in a certain number of cases.

Sparks may be applied over the spine and general muscular areas of the body for their tonic effect at any stage of the disease, but, as a rule, they had better not be applied to joints wherein acute symptoms are manifest. When the acute process has subsided, however, and the local phenomena have become confined to soreness and fibrous enlargement, I know of no measure which will so frequently prove effective in removing both as judiciously applied static sparks.

The various neuralgias which accompany the disease are also amenable, as a rule, to the static spark.

The static wave current localized over the solar plexus and abdomen will sometimes give excellent results in the gastric and intestinal indigestions which are frequently quite troublesome.

D'Arsonvalization.—The general application of the high frequency current administered by means of the spiral wire cage of d'Arsonval, or the auto-condensation cushion of Piffard, seems to promise much because of its strong tonic influence upon the nervous system and general metabolism, but enough has not yet been done with it in this disease to render possible the formation of reliable conclusions. It has seemed to have exercised a beneficial influence upon some cases in the treatment of which we have used it, enough to encourage us to continue observations upon it in the future.

The Continuous Current.—This modality, in the form of central galvanization, positive polarity active, negative dispersing electrode over the solar plexus, is very helpful in improving the patient's general condition and as a sedative to the nervous system, but I have never been able to secure any local effects with it in this disease upon the joint conditions that I could not have secured just as well, and usually better, with something else, whether the current volume was weak (5 ma.) or strong (75 ma.), except in muscular spasm due to nerve irritation; in the torticollis of arthritis deformans the continuous current, in doses of from 5 to 20 ma. for fifteen minutes, will sometimes give more satisfaction than anything else as regards relief of both pain and spasm.

In applying central galvanization, the brain is treated first, and it should be remembered that great care must be exercised when using this current upon this region of the body. Beginning with the current at zero, it should be increased gradually, diminishing the volume immediately if dizziness, faintness, or nausea occurs; it is very easy to throw a patient into syncope during this operation. Usually from 3 to 5 milliamperes for three or four minutes will be enough. In the cervical region the milliamperage may be increased to from 5 to 15, according to

the patient's tolerance, for five minutes. The dorsal and lumbar regions may be treated for five minutes each, and, as no dangerous symptoms are to be feared in these vicinities, the current volume may be increased until the cutaneous sensibilities revolt, which occurs ordinarily at from 20 to 30 milliamperes.

It has been stated that the soreness in the joints may be relieved by treating them with weak galvanic currents, positive polarity, using a hot-water bath in which the affected members are immersed as the active electrode. Although we have tried this repeatedly, we have never been able to convince ourselves that any more benefit resulted than would be produced by the hot water alone without the current, and in acute cases the suffering has occasionally been increased apparently. It is unquestionably greatly inferior to the static modalities, faradism, and dry hot air in this situation.

Magnetic-Induced Current.—This current plays very little part in the treatment of arthritis deformans when a static machine is available, but when it is not, a good high tension coil is very useful as a temporary sedative.

The current is passed directly through the aching joints with a strength as great as is consistent with the patient's comfort, and the relative positions of the polarities is usually a matter of indifference. In the form of spinal and general faradization, it exercises a very helpful influence upon the deep nerve centers and general metabolism. In rare cases it will be found that the coil gives sedative results in this disease superior to those produced by the static modalities or dry hot air. It may be applied as often as pain demands it without injury to the patient.

Mechanical Vibratory Stimulation.—This remedial agent has not yet been used extensively enough to justify the formation of an opinion as to its curative powers in the treatment of this affection. It is undoubtedly, however, a powerful general tonic; it will relieve the pain of muscular spasm and relax the spasm more effectively than any other measure with which I am acquainted except anæsthesia, and it is powerfully and harmlessly sedative to the irritable nervous system; in all of these capacities it enters logically into the management of ar-

thritis deformans, and will be found practically of decided value and assistance.

Massage.—Massage, either general or local, will very rarely have to be considered in the treatment of this affection when the agencies already mentioned are available. When they are not, however, it will be found useful in relieving pain, locally, and in improving the patient's condition generally.

Diet.—The widespread impression that gout and rheumatism were largely concerned in the etiology of the disease is responsible for the common practice of denying these patients red meats, and sometimes all meats. We believe that this restriction is not only unnecessary usually, but that it frequently inflicts positive harm upon the patient. Malnutrition is an almost constant characteristic of this disease, and the more nourishing and generous the diet, within reasonable limits, the more will the progress towards recovery be facilitated.

These dietary limits are represented by the capacity of the individual patient for digesting and assimilating his food, and must be defined, as regards both quantity and variety, by this capacity as ascertained in each individual case. It has been our experience that, as a rule, meats of all kinds except pork are well digested and assimilated by these patients, and are beneficial, and that restriction is much more frequently required with reference to the starches and sugars. Intestinal indigestion demands attention in these cases with a moderate degree of frequency.

Clothing.—In any disease exhibiting more or less constant pain as a symptom, a good quality of woolen underclothing, of light weight in the summer and moderately heavy in the winter, is a source of comfort to the patient in protecting the skin from sudden changes of temperature, which are liable to increase the pain; arthritis deformans is no exception to the rule.

Protection of the skin by woolen undergarments renders another service by maintaining the function of this emunctory, which is so important a factor in the general bodily metabolism. Impairment of general metabolism is usually a prominent feature of this disorder.

Drugs.

The drug treatment of uncomplicated arthritis deformans confines itself within very narrow limits, and is unsatisfactory in the extreme, as far as the obtaining of curative results is concerned. The internal administration of medicines is indicated for two purposes; to favorably influence the course of the primary disease process, and to mitigate the symptoms.

Alteratives and Tonics.—Only a very few elements of the materia medica have succeeded in gaining a lasting reputation in this connection, and all of those that have, except the salicylates, are of the "Tonic" and "Alterative" classes, hence exert their beneficial influence through their power to improve the general metabolic functions. Prominent among these may be mentioned the iodide of iron, cod liver oil, the hypophosphites, arsenic in its various combinations, strychnia, the chloride of gold and sodium, and potassium iodide.

The first mentioned has given us the best results, improvement usually manifesting itself, when it obtains at all, in about three weeks after the commencement of its administration. It should be given for periods of from three to six weeks, with intermissions of two or three weeks.

Cod liver oil does good service in those cases characterized by emaciation, if well borne by the stomach.

Arsenic and strychnia are fairly useful in many instances as general tonics.

The chloride of gold and sodium and potassium iodide or hydriodic acid sometimes seem to render considerable service, but they fail to influence the disease in such a large proportion of cases that their efficiency is not nearly as great as is generally supposed.

Quinine has been lauded as a remedy for arthritis deformans, but we have never been able to convince ourselves that it was of any service in any of the cases to which we have administered it, and regard its claim to efficiency in the management of this disease, *per se*, as open to grave doubt.

The Salicylates.—The relation of the salicylates to this disease deserves a special mention, as they sometimes render

excellent service in relieving pain and swelling. Although it is improbable that rheumatism is an etiological factor in any considerable number of cases, yet it is not so very uncommon to see an attack of rheumatism engrafted upon an already existent arthritis deformans, and, as the salicylates fail absolutely in so many manifestly uncomplicated cases, it seems reasonable to consider that many of those in which they are useful are instances of such a complication. The fact that beneficial influence is obtainable by their use only up to a certain point would favor this view. The difficulty of making a positive diagnosis of rheumatic invasion under such circumstances is, in many cases, of course, insuperable. Whatever the explanation, the fact remains that the salicylates, especially aspirin, are sometimes very helpful in relieving painful joint conditions occurring during the course of arthritis deformans.

Laxatives.—Constipation is sometimes present in a degree to demand attention, and the various mineral waters, sodium phosphate, magnesium sulphate, the aloin, strychnia, and belladonna mixture, or compound licorice powder, will be found helpful. What particular one should be used must be determined by the tolerance of the individual patient.

Digestants.—Digestive disorders can generally be controlled by regulating the diet, but the digestive ferments, carminatives, charcoal, bismuth subnitrate, and strychnia will sometimes have to be called upon to assist in this work.

Pain-Relieving Agents.—The constant harassing pain is one of the most troublesome symptoms of the disease as far as management is concerned. Most of these patients have become so habituated to pain that they bear a moderate amount without much complaint, but sometimes severe exacerbations, lasting for several hours, days, or weeks, will occur which demand attention. Opium, or any of its derivatives, is inadvisable because of the chronic character of the trouble, because it loses its influence in a very few days unless given in increasing doses, and because of its evil effects upon the system at large. We have occasionally given coal tar derivatives when the paroxysms were very severe, but they also produce undesirable effects upon the metabolic and circulatory functions when continu-

ously administered in effective doses for any length of time. None of the ordinary pain-relieving drugs are of much service in controlling this symptom, with the exception of the salicylates, as hereinbefore mentioned.

Much relief, however, can usually be obtained by the use of external applications, and baume analgesique (Bengue), the tincture of iodine externally, and the various anodyne lotions have given us better results than anything else. The hot water bag, or in some cases, the ice-cap, is very useful in this connection, but when the latter is used the effect should be closely watched, as it will occasionally precipitate severe neuralgias if applied too long.

Management of Affected Joints.

During the acute stages the joints involved should be kept at rest; I do not mean such complete rest as would necessitate enclosing the member in a splint, but the patient should be directed not to use the joint to such a degree as to produce pain. Patients are sometimes urged to force the joints to functionate no matter how exquisite the anguish induced, and the effect is usually to increase the local pathology already present, to say nothing of the evil influence upon the general nervous system; nothing is more depressing than severe and long-continued pain. These remarks also apply to passive movements.

After the acute process has subsided, judiciously-regulated, gradually-increased movements of the stiffened joints, both active and passive, are beneficial, and frequently partial anchylosis can be entirely removed thereby, but the sudden *forcible breaking down* of the anchylosis of arthritis deformans, when it exists to any great degree, is a procedure which we have never seen followed by anything but evil results in the way of increased and usually entirely hopeless anchylosis, and in mentioning the procedure I desire to express my conviction that it should be expunged from the therapeutical category of this disease.

Routine Treatment.

Although dry hot air alone will cure some cases of arthritis deformans, yet, as I have already said, it is sufficiently

difficult to benefit the majority of these patients materially, even when we use all the resources at our command; this implies the desirability of giving them the benefit of everything that is known to exhibit helpful properties, and brings up the question, "What are the most advantageous combinations?" That which has given us the most satisfaction as a routine treatment, to be modified according to the conditions surrounding the individual cases, is as follows:

1. A diet as generous as can be digested and assimilated by the individual case, and consisting largely of red meats.

2. Rest in bed for at least twelve hours out of the twenty-four.

3. A pill consisting of 1-40 of a grain of strychnia sulphate, and 1 1-2 grains of ferrous iodid three times daily half an hour before meals, and in the emaciated cases one to four drams of cod liver oil three times daily after meals.

4. A dose of some one of the mineral waters or sodium phosphate before breakfast, every two or three days, if constipation is present.

5. A body dry hot air treatment two or three times weekly.

6. Central galvanization once or twice weekly.

7. A general application of mechanical vibratory stimulation two or three times weekly.

8. A static electrical application at least once every day, consisting in acute cases of the Morton wave current localized over the affected joints or spine, and in the chronic cases of long, thick sparks to the affected joints one day, and the Morton wave current localized over these joints the next. In some cases some one of the high frequency currents applied either locally or generally may advantageously replace some of these static applications or be added to them.

9. With anchylosed joints, wherein the acute condition has subsided and the functional impairment is not due to osteophyte formation (and in our experience it has not frequently been due to this condition), passive movements every day, in the form of alternate forced flexion and extension, the attempt being made to increase the excursion of the manipulated member each time, are of considerable use. The movements should

not be violent enough to produce sudden breaking down of the offending tissue, or to cause the patient much pain, otherwise the original pathological process is very likely to be re-awakened and the last condition of the victim will be worse than the first. The effects of these movements should be carefully watched, as this same evil result will follow if they are commenced too early.

The advantages contingent upon temporary suspension of treatment, which were suggested in the section upon "Intermissions in Treatment," Chapter III., are sometimes very noticeable in arthritis deformans. Our custom is to keep the patient at the sanitarium for six or eight weeks, or until he has improved substantially, for the first course, and then send him away for a month; he then returns to the sanitarium for three or four weeks more, after which he is recommended to go away again. The time duration of the courses of active treatment, and of the intervals between them, will, of course, have to be governed by the conditions surrounding the individual cases as regards the degree of improvement attained, etc.

RELAPSES.

Cases of arthritis deformans are very apt to relapse during the first year after recovery. A very common cause is an attack of some acute disease of a debilitating nature, as la grippe; another is that patients who have been accustomed to an active life before the disease disabled them are so elated and confident at being again in condition to do something after months, and sometimes years, of enforced idleness, that they overwork. The overstrained nerve centers yield as they did before, and another outbreak obtains. In fact, anything tending to lower the general vitality is liable to result in a reappearance. It may involve the same old joints, or entirely new ones may be invaded, and those affected previously escape altogether.

The victims should be gotten under thorough treatment again as soon as possible, and this should be persevered in until recovery supervenes. Under the very best of conditions recovery is a matter of months, but when we reflect that in the

past we have been able to accomplish scarcely anything with any degree of certainty in any length of time, the possession of measures which will restore to some of these victims useful joints and comfort in living is a matter upon which we may most sincerely congratulate ourselves and our patients, however long it takes to do it. Perseverance is a grand omniscient word in the treatment of this affection.

CHAPTER X.

PERITONITIS; PLEURITIS; SYNOVITIS; NEURITIS AND SCIATICA; LITHÆMIA AND GOUT; NEURALGIA AND MYALGIA; VARICOSE ULCERS; OTITIS.

In the preceding chapters the different phases of the physiological action and clinical results of dry hot air applications have been discussed and illustrated with sufficient thoroughness to render apparent what effects may be expected to follow their use in most of the pathological conditions commonly encountered, and how these effects are produced. In the affections which remain to be considered, therefore, the subject will need to be treated but briefly.

PERITONITIS.

Varieties.—This disease is usually secondary to some other affection, as benign or malignant tumors, salpingitis, appendicitis, etc. It is also caused by tuberculous infection of the peritoneum, sometimes apparently by microbic invasion from the intestinal canal, and occasionally an instance is encountered during the course of, and seemingly traceable to the specific etiological factor pertaining to, an infectious fever.

Sphere of Usefulness of Dry Hot Air.—When peritoneal inflammation is microbic in causation and confined to the membrane itself, it will usually yield kindly, rapidly, and permanently to dry hot air; the condition, under these circumstances, may be likened to local septic infection, as far as thermotherapy is concerned. When it is secondary to some other condition, however, permanent cure will necessitate eradication of the exciting cause. When this cause is a benign neoplasm, operative interference must be considered; if the growth is malignant, operation or X-ray exposures, or both in many cases; if a deep, localized septic process, as appendicitis

for instance, operation must always be considered early and earnestly.

One of the most prominent and harassing symptoms accompanying nearly all forms of peritoneal inflammation, except that due to the tubercle bacillus, is pain. Dry hot air will always relieve completely that proportion of it which is caused by the peritonitis proper, and, as this remedy may be applied as often as the pain recurs, the patient's comfort may be maintained indefinitely.

In salpingitis coming under treatment moderately early and before suppuration has been established, the knife will rarely be needed for obtaining control of the condition. The body treatment two or three times a week, in combination with the local once or twice daily, will usually effect a rapid and complete subsidence of the pathological process, and the writer has seen several cases recover under the local application alone. The body treatment, however, always hastens the result, and in some cases its use is imperative. The deeply-seated aches and pains due to the salpingitis itself are controlled by the body treatment more effectually than by the local application in many cases.

The writer has never had the courage to rely upon the thermal agent alone for the cure of appendicitis, but Burwash of Chicago reports two cases which he carried to a successful termination with this measure only. It seems to me, however, that in view of the ever present difficulty, if not impossibility, of differentiating clinically those cases of appendicitis which are due to impaction of a foreign body from those which are caused purely by germ infection, we should not feel justified in abandoning early operation for the treatment by dry hot air. If all cases were of the latter etiological type, thermal applications would undoubtedly prove curative in the vast majority of instances, but they could not, and should not, be relied upon exclusively in the former. This agent is very effective in limiting inflammatory processes, and, as repair of wounds and abscess cavities is always greatly hastened by its use, it may be applied while waiting for operation if pain is troublesome or when the patient is sufficiently ill-advised to refuse operation.

In tuberculous peritonitis, the occasional splendid results which have followed a simple laparotomy give ground for the belief that this agent may prove to be of benefit here. The most probable explanation of the way in which laparotomy has accomplished its effects seems to be that the absorptive power of the peritoneum, which is enormous under normal conditions, is rescued from a temporary inhibition, which has resulted in so impairing the physiological resistance of the membrane as to allow pathogenic germs to gain a lodgment and proliferate, by the operation; that the congestion due to allowing the air or irrigating fluids to come in contact with the membranes, so influences their function as to bring about the encapsulation and ultimate phagocytic destruction of the invading micro-organisms. Dry hot air possesses the power of inducing physiological congestion, hence restoration of impaired absorptive function, to a degree unapproached by that of any other measure now known, and if this is the true explanation of the effect of laparotomy, the thermal agent should be valuable in this affection.

The influence of the body dry hot air application in eliminating general toxæmia and stimulating the general physiological resistance, is as marked in this disease as elsewhere, is always of great assistance in securing a favorable termination, and in many cases constitutes the measure most to be relied upon.

Illustrative Case.

It was the results following its employment in a case of acute peritonitis that first suggested to the mind of the writer that dry hot air might be useful in pathological conditions other than rheumatic ailments and traumatic joint affections. The case was reported in the *New York Medical Journal* in 1899, and is such a striking illustration of the splendid results sometimes obtained by the use of thermo-therapy in this disease that I quote it from that periodical as follows:

"Miss L. L., waitress. Was called to see the patient at 2 o'clock A. M., November 8, 1898, and found her suffering with severe colic. She had been feeling poorly and suffering from slight cramps in the bowels for a week past. Abdomen was

tense and tender, this last being especially marked in the left iliac fossa. Bowels had been constipated during the preceding week. Pulse, 72; temperature per mouth, 98.6° F. I made a provisional diagnosis of colic from indigestion and constipation, but as patient was living in illicit relation with a man about town and as I had previously met with some trying surprises in the way of abdominal inflammations during my practice, I decided to call again and watch her progress. I administered morphine, a quarter of a grain, and ordered magnesium sulphate in teaspoonful doses hourly, to be begun in the morning and taken until bowels moved, then discontinued. Patient was comfortable, so far as pain was concerned, in half an hour, and I returned to my couch and resumed my interrupted slumbers.

"Same day, 6 P. M.—Found patient suffering acutely from severe cutting pains all over the abdomen; pulse 106, temperature 100.5° F. Abdomen tense, acutely sensitive to touch, but focus of tenderness still remained in left iliac fossa which region was entirely intolerant of manipulation. I was unable to find anything specific in the neighborhood of the appendix, changed my diagnosis to gonorrheal salpingitis and peritonitis, and was glad that I had called again. Morphine had controlled pain pretty well for four hours, after which it returned and continued with increasing intensity up to the time of my visit. Magnesium sulphate had produced two small thin movements, accompanied by sharp pains. I made up my mind that I was in for another of the harassing experiences which go to make up the ordinary management of these cases, ordered that flannels wrung out of hot water be constantly applied to the abdomen as hot as could be borne by the patient, gave her another hypodermic, left her two quarter-grain morphine pills to be taken in case the pain became unbearable before my next visit, and put her on an exclusive milk diet.

"November 9, 12 M.—Patient had been suffering intensely since midnight. Knees were drawn up, abdomen much distended, unable to make the least movement without provoking excruciating agony, which was also occasionally exacerbated by attacks of retching which accomplished nothing; she was shivering and her teeth were chattering from the exhaustion due to long-continued suffering. Pulse 104; respiration 28, very shallow and quick; temperature 101.2° F. The morphine pills that I had left at my previous visit had not been used, as I had requested her not to take them unless it was absolutely necessary. With the proverbial capacity of her sex for enduring pain, she had not considered that the point of absolute necessity had yet been reached. I realized that something must be done, but I hated to inaugurate a systematic course of morphine with

its resultant evils, particularly undesirable in a disease of microbic origin where it is of the first importance to preserve the metabolic activities of the body unimpaired; as the hot applications were doing no good, however, it seemed the only measure capable of dealing with the situation.

"While I was considering, the attendant came to the bedside to renew the hot application. The patient looked up at her and exclaimed, 'Oh, is it very hot?' Upon being assured that it was, she remarked, 'The hotter you get it the better it feels.'

"Like a flash my dry hot air apparatus rushed into my mind. With it I could apply a heat of 500° F., whereas the flannels could not be used at more than 160° F. I asked her if it was true that the greater the heat the greater the comfort she experienced. She answered that if the flannels were not very hot they gave her no relief at all. A small ray that was hardly strong enough to be hope brightened the darkness. If 160° F. of heat gave her some relief from pain twice or three times that might give her a good deal, and by frequent repetitions I might be able to avoid the morphine. The prospect was worth the experiment. I told her that I would try something else in the afternoon, and did not administer any morphine.

"At 4.30 P. M. I applied dry hot air locally over the abdomen with doubt, fear and trembling. My gratification can better be imagined than described when, at the end of ten minutes, the sufferer's face relaxed its pain-distorted lineaments. In thirty minutes she looked up at me with a quiet smile, saying, 'Oh, how good that feels!' and in forty-five minutes, while still under treatment, she had fallen exhaustedly asleep for the first time in thirty-six hours.

"At the conclusion of the treatment the patient expressed herself as being entirely free from pain while she kept still, but when she moved it was still there, and manipulation was as little tolerated as before. I left the apparatus there, directed that I be called immediately when pain returned, and departed walking upon air because of the result achieved. I expected, of course, that a repetition would soon be necessary. However, I had been able to give her a relief so perfect that even morphine would have been inadequate for its accomplishment, and by withholding the drug had been able to preserve her mental and physical functions unimpaired. If I could keep this up I would be willing to treat her every hour, if necessary. The hours wore on, and to my growing astonishment I received no summons until, by the following morning, I began to fear that another physician had been substituted for me without the formality of my discharge having been observed. I found it diffi-

cult of belief that the treatment could have produced results so happy and so long continued.

"10th, 12 M.—Patient greeted me smilingly, reporting that relief from pain had continued complete until nine o'clock the preceding evening, when, for about fifteen minutes, she suffered from slight cramps. At midnight she had severe cramps for an hour, but none since, and to make a long story short, I will say here that those were the last pains she suffered. The abdomen was relieved of its distention; tenderness upon pressure had entirely disappeared from the right abdomen, but was considerably in evidence in the left, and very much so in the umbilical region and below, from manipulation of which area she shrank in terror. Bowels had functionated spontaneously and with little pain; was taking milk freely and stomach was not at all irritable. Pulse 72; respiration 18; temperature 98.6° F. Dry hot air was again administered.

"Same day, 6 P. M.—Patient was and had been entirely comfortable. Pulse 83; respiration 18; temperature 99° F. Directed that I be called again if pain recurred, and did not see her again until the next day.

"11th, 10 A. M.—Patient had slept uninterruptedly all night and was feeling hungry. No tenderness was present anywhere in the abdomen except over a small area immediately inferior to the umbilicus. Pulse 72; respiration 16; temperature 98.6° F. Dry hot air administered.

"Same day, 9 P. M.—Patient had been sleeping some during the day, was entirely comfortable and complained of only very slight tenderness on pressure in umbilical region. Pulse 66; respiration 18; temperature 98.6° F.

"12th, 8 P. M.—Found patient sitting up, dressed, sewing. No pain or tenderness upon pressure was anywhere discoverable. Pulse 76; respiration 18; temperature 98.6° F.

"15th, 8 P. M.—Patient called at my office by appointment. Pulse 78; respiration 20; temperature 98.6° F. Examination revealed slight tenderness upon deep pressure over left Fallopian tube; nowhere else. Once more administered dry hot air and requested that she report in three days.

"18th.—Reports that she returned to her work yesterday morning. Feels as well as she ever did in her life, and searching examination betrays absolutely no sign of her late illness. She wrote me a letter from another city two months later, stating that she was, and had been, perfectly well since I last saw her."

Treatment.

Local Dry Hot Air Application.—The patient should be prepared as described in the chapter upon "Technique" for the abdominal application, the apparatus connected and the heat turned on; in fifteen or twenty minutes the patient will be free from pain. The application should last an hour when it is possible to maintain it that long without the induction of undue fatigue, and the temperature should be raised to from 350° to 400° F. When the application is finished the patient is merely made comfortable again in bed, no special after-treatment of the abdomen being required. The treatment may be repeated as often as the pain returns, but should be applied twice daily anyway for the first four days, however comfortable the patient may be.

General Dry Hot Air Application.—The technique of the body treatment in this disease does not differ from that usual in this procedure. As the body temperature is usually considerably above normal when the patient enters the apparatus, it cannot always be relied upon as a guide to the duration of the séance or the intensity of the heat; the pulse acceleration and the general effect upon the nervous system must govern. As a rule the treatment should last about half an hour, and the pulse should be accelerated to 125 or 130 beats per minute. It is ordinarily not wise to push it beyond 140 beats per minute, and the phenomena indicating over-stimulation should not be induced.

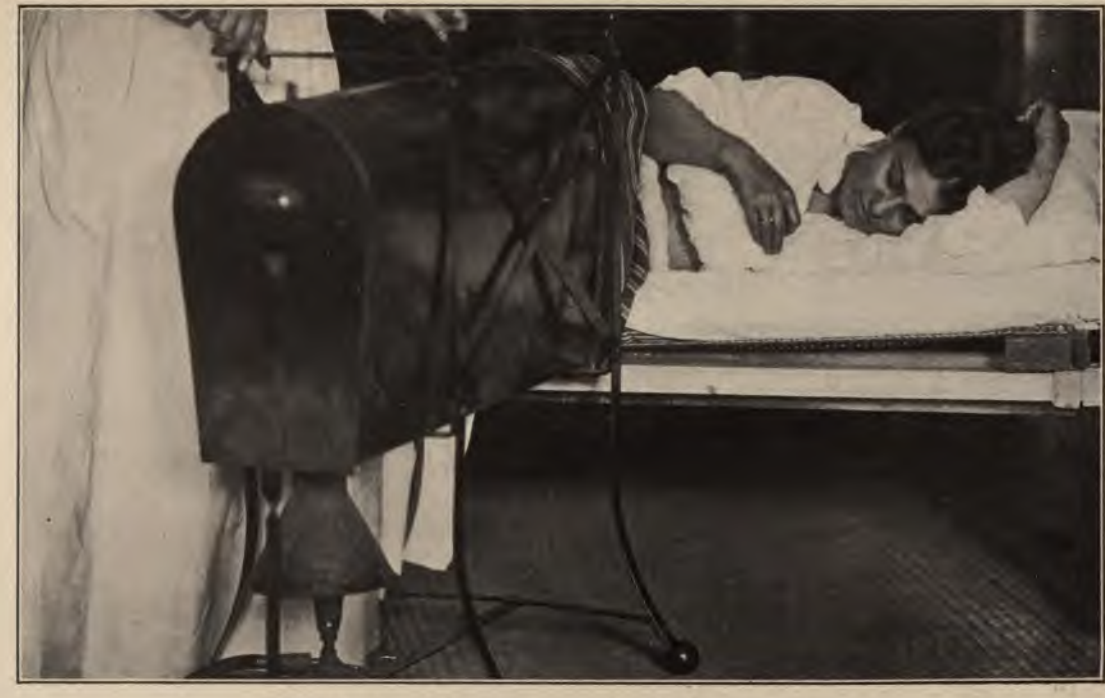
The frequency of administration is governed by the response on the part of the patient. It will usually be well to apply the measure every other day during the first week, after which the interval may be lengthened.

Additional Remedial Measures.

Aside from the ordinary care of the alimentary canal, incident to this affection, surgical measures constitute the only means additional to thermo-therapy that will have to be considered in the treatment of peritonitis.

When the exciting cause is salpingitis, long-continued intra-

XXVII.—Patient Prepared for Local Application of Dry Hot Air to Abdomen.



XXVIII.—Local Application of Dry Hot Air to Abdomen.

vaginal applications of the rapidly-interrupted current from the long, fine-wire faradic coil through the bipolar electrode, will sometimes give temporary relief from pain, but the writer has not infrequently seen suffering increased for several hours thereby; its use therefore is not to be unqualifiedly recommended in all cases.

The internal administration of drugs for the relief of pain is almost never called for, and drug stimulation is entirely superfluous when a body apparatus is at hand and usually when the local treatment is employed alone.

The advantages dependent upon the employment of this agent in peritonitis, viz., rapid relief of pain, restoration of absorptive function to the membranes, etc., have been sufficiently dwelt upon to warrant omission of further mention, and anyone who has carried a patient through an attack under ordinary management will be in a position to readily appreciate the value of the service it renders.

PLEURITIS.

Varieties.—Of the pleurisies it may be said, as of peritonitis, that they are usually secondary to some other affection, as pneumonia, pulmonary tuberculosis, malignant disease, etc., and as in peritonitis also, it is evident that the permanent cure of secondary pleurisies will necessarily involve removal of the exciting cause. There is another class of pleural inflammations, however, which seem to originate in the membranes themselves primarily, and which are at times most refractory. They are accompanied by effusion into the pleural cavity and may be divided for thermo-therapeutical purposes into two classes, viz., those in which the effusion is serous or fibrinous—hydrothorax and "dry pleurisy" respectively—and those in which the exudate consists of pus.

Sphere of Usefulness of Dry Hot Air.—The pleurisies accompanying pneumonia, as we have seen, and pulmonary tuberculosis, as we shall see later, yield rapidly to dry hot air applications, both as regards their symptomatology and intrinsic pathology.

Enough cases of hydrothorax and "dry pleurisy" have also

been treated to demonstrate that this agent is capable of rendering valuable assistance here; that aspiration will have to be done less frequently under such management, and that when it is done the return of the pleural membranes to normal structure and function will be quicker and more frequent than it is at present. A very convincing case was reported by Burwash in the *Chicago Medical Recorder* for December, 1901. The diagnosis indicated by the physical signs was confirmed by withdrawing some of the fluid through an exploring needle, and the patient was ill but four weeks from the inception of the attack to its termination. The effusion was extensive enough at one time to produce dyspnœa and interference with the heart action. The local application only was used and diuretics and strychnia were administered in combination therewith.

The treatment of pyothorax, however, is, always has been, and of course always must be, operative interference; but many cases refuse to recover even when resection has been done, and there is reason to believe that dry hot air is capable of reducing the number of these incurables and of greatly hastening recovery in all post-operative cases. As these patients are usually debilitated subjects, it is always wise and sometimes necessary to invoke the influence of the body treatment upon general metabolism, as well as the direct effect of the local application upon the pleuræ.

Treatment.

Local Dry Hot Air Application.—The local treatment should be used twice daily for an hour at from 350° to 400° F., until improvement is manifest, and once daily thereafter, until recovery is complete. The preparation of the patient and the technique are the same as have already been described in the section on pneumonia.

General Dry Hot Air Application.—The body treatment should be applied two or three times weekly according to the effect upon the patient's general condition, and the technique is that usual to this procedure. As the bodily temperature is not ordinarily much elevated in this affection its fluctuation during the séance will usually be of value in determining

the length of the treatment and the intensity of the heat required.

Additional Remedial Measures.

The other methods of physical therapeusis are rarely of value in pleuritis, and the dietary, drug, and surgical management of the disease do not differ from those commonly incident to the affection, except that anodynes and stimulants are very rarely called for when dry hot air is attainable.

SYNOVITIS.

Varieties.—The vast majority of synovial inflammations are due to one of four etiological factors, viz., trauma, rheumatism, gonorrhea, or tuberculosis. The writer's experience with dry hot air in this affection has been confined principally to cases owning the three first-mentioned causes, and it has been eminently satisfactory.

Sphere of Usefulness of Dry Hot Air.—It is hardly necessary to state that a case of synovitis of any sort should be gotten under treatment as early as possible. If the traumatic form is attacked by dry hot air within three or four days after the injury has been sustained, the pain will be relieved at once and the case will ordinarily reach a successful termination within three weeks. I have never seen one last over six weeks even when ten days had elapsed since the injury, and Corwin has reported one case of acute synovitis of the knee in a boy fifteen years old, exciting cause not stated, which recovered completely with but two treatments. It is the writer's belief, however, that such a rapid response is very rare, and he has personally never seen a case of true synovitis, whatever the etiology, recover in such a short time, however early it came under treatment.

In the rheumatic variety, on the other hand, rapid response is the rule when appropriate medication accompanies the dry hot air; the pain is relieved at once, and recoveries with but four or five applications are not at all uncommon.

In gonorrheal synovitis it is, of course, essential that treatment be directed against the primary focus of infection as well

as the joint mischief, but the use of dry hot air on the joint affected will greatly hasten the recovery and anchylosis will usually be avoided thereby. This is one of the situations wherein the agent cannot invariably be relied upon to effect immediate relief of pain; it sometimes makes it worse for several hours afterward. The ultimate result attainable justifies its application even under these circumstances, however, unless the pain is exacerbated to an unendurable degree.

Tuberculous synovitis is the most resistant of the varieties to this as to all other methods of therapeusis. A cure requires from two to six months, but in the majority of the cases so far reported the joints have eventually been restored to useful function, and that without operative interference. If surgery has finally to be called upon the prospect of ultimate cure is greatly increased if dry hot air has been applied, because of the improvement in the local nutrition effected by this measure.

Walton has reported most excellent results in tuberculous synovitis, and although our experience has been slight, yet it has encouraged us to undertake further investigation. One case in particular responded most happily. The patient, a boy seventeen years old, had been afflicted with tuberculous disease of the knee-joint for several years and for the preceding four years had been under the most approved treatment. He came to the sanitarium with the leg in a splint and the joint anchylosed. A course of local and general dry hot air applications, extending over a period of five months, restored seventy-five per cent. of the normal motion to the joint, enabled him to dispense entirely with the splint, stopped his daily temperature elevations and night-sweats, increased his body weight, and, in short, brought about a condition of normal health. Near the close of the course of treatments this patient was exhibited by the writer before the Clinical Society of the New York School of Physical Therapeutics.

It is probable that dry hot air produces its beneficial results in joint tuberculosis by improving the nutrition and increasing the cell vitality of the part, rather than by a directly fatal influence upon the bacillus itself, as has been suggested. If the germ were directly destroyed by the heat, the recovery would

be immediate, whereas it is in fact always found to be more or less slow.

It has been said that dry hot air is contra-indicated in joint tuberculosis, but as this statement is not warranted by the pathology of the condition, the physiological action of the agent, or actual clinical experience, it may be dismissed from further consideration.

Treatment.

The knee is the joint most frequently affected in synovitis and the local treatment the one most frequently indicated.

Local Dry Hot Air Application.—The apparatus designed especially for this joint would seem to be the one most likely to be useful in this situation, but for the reasons stated in Chapter III. the general local apparatus will give better results when the joint is susceptible of sufficient extension to permit of its use. The technique appropriate to the special knee apparatus is fully described in Chapter III., in the section that treats of this machine.

When the general local apparatus is used the wrapping should be started at the toes, and the whole of the limb, from the toes to a point a little above the middle of the thigh, invested in three thicknesses of the toweling. The limb is then placed in the apparatus, the limiting attachment fastened around the middle of the thigh, and the heat run up to about 400° F. Whichever apparatus is used, the treatment is continued for an hour and administered twice daily, or oftener if the pain becomes troublesome.

After-Care.—In the traumatic variety, after the application has been completed, it is wise to wrap an elastic bandage about the joint just tightly enough to produce a slight, even pressure, and this should remain in place until the next treatment.

In rheumatic synovitis no compression or immobilization device is called for. It is desirable only that the patient refrain from moving the part, and this he will ordinarily do of his own volition.

When the exciting cause is gonorrheal infection, the persistent pressure of an elastic bandage can rarely be borne, but it

is advisable to secure immobility of the joint by applying a splint or some retaining apparatus until the acute inflammatory process has subsided. Passive motion may then be employed immediately after each treatment.

Whether or not immobilization shall be applied in tuberculous synovitis must be determined, of course, by the conditions obtaining in the individual case.

General Dry Hot Air Application.—The body treatment is always extremely helpful in synovitis of any sort, but it is rarely imperatively indicated in cases due to trauma or rheumatism; in gonorrheal cases, however, recovery is always markedly hastened by its employment, and frequently a satisfactory result cannot be attained without it. We have here a condition comparable in many respects with that obtaining in local septic infection, and the technique of the application here is the same as that described for septic infection.

Much the same may also be said of tuberculous synovitis, in which disease the writer is of the opinion that the body treatment should always be employed. We have here, not only a localized process, but an impairment of the vital functions generally and, as we have seen, no measure is more effectual in combating a general debility than the judiciously-administered general dry hot air application.

Additional Remedial Measures.

Electricity, in the form of the Morton static wave current, the static spark, or galvanism, is very useful in traumatic and rheumatic synovitis, the efficiency of the modalities being in the order in which they are named. The high frequency current has been used considerably abroad in all varieties of synovitis and good results reported, but dry hot air, alone, or in combination with one or more of the above-mentioned agents, will ordinarily give results which leave little to be desired when the lesion is due to trauma or rheumatism.

The Morton wave current or the brush discharge will sometimes give good results in relieving the pain of the gonorrheal variety, but operative interference constitutes the most important curative adjunct to be considered in this condition.

In tuberculous joint inflammation the latest therapeutical development is the X-ray, and this agent has produced most excellent curative results in some cases of this affection. It may be administered in conjunction with dry hot air without necessitating any modification of the usual technique pertaining to either agent.

The dietary and general management of a case of synovitis that is being treated by thermo-therapy does not differ from that ordinarily indicated, except in the greatly-lessened frequency with which pain-relieving drugs are required.

NEURITIS.

Etiology.—This affection is another of those owning a varied causation. Prominent among its causes are excessive use of certain sets of muscles and nerves, which is exemplified by the brachial neuritis sometimes encountered among penmen; the presence of abnormal substances in the blood, illustrated by the neuritis of alcoholism, plumbism, and the infectious fevers; and traumatism. Lithæmia and other constitutional aberrations are also met with among its causative phenomena, and there can be no doubt that sudden chilling of the body under certain conditions will inaugurate an attack, although the manner in which it does so is not entirely clear. A neuralgia so induced would not be difficult to understand, but in the case of a true neuritis it would seem as if something else must also be etiologically involved, and it is probably through an inhibitory influence of cold upon general metabolism, whereby abnormal and irritating products are developed in the circulation, that the attack is provoked.

Treatment.

It will readily be appreciated that removal of the exciting cause is a necessary factor in the attainment of a cure.

Dry Hot Air.—The use of this agent in neuritis is, on the whole, somewhat disappointing. The local application will nearly always relieve the pain for a time, but it almost invariably returns after a little as badly as ever, and I have never been able to convince myself that it possessed much, if any,

value as a curative agent. The body treatment is more useful, however, and especially in those cases dependent upon constitutional causes it is fairly efficient. Even at the best, however, dry hot air alone is not a very reliable measure.

Additional Remedial Measures.

Electricity.—The best results are obtainable with the electrical currents in combination with thermal applications, and my routine treatment is to apply the body treatment two or three times weekly and some electrical modality twice daily, except on the dry hot air days, when one electrical treatment is omitted. The local application of heat is used *ad libitum* when the pain is troublesome, in those cases wherein experience demonstrates its value.

The electrical modalities used are the static wave current, the brush discharge and spray in recent cases, and sparks and weak galvanic currents in chronic cases. Some authorities do not countenance the use of galvanism in neuritis, and in many cases it will unquestionably make the trouble worse. In other patients, however, currents of from three to ten milliamperes will just as unquestionably produce beneficial results, and if a case is not doing well under other measures I believe that it should be cautiously tried.

The rapidly-interrupted current from the long, fine-wire coil is excellent for sedation, but I have never observed that it exercised much, if any, curative influence in true cases of this disease.

Diet.—The regulation of the ingesta will depend upon the conditions obtaining in the individual case as regards idiosyncrasy, and whether or not constitutional and diathetic factors are involved in the etiology.

Drugs.—Medicines are not efficient against a neuritis, *per se*, but they are useful for removing some of the constitutional conditions upon which it frequently depends, as lithæmia, plumbism, etc., and for relieving pain. They will rarely be required for the latter purpose when dry hot air and electricity are available, but when they are required the coal tar derivatives will usually give good satisfaction. As the affection very

frequently becomes chronic, the administration of morphine should be reserved for a last resort and given most guardedly then. Its after-effects are frequently most vicious as far as the neuritis itself is concerned, to say nothing of the very present danger of making an *habitué* of the patient.

Physiological Rest.—Suspension of function of affected parts is always helpful and sometimes imperative for restoring the nerve to its normal condition.

Sciatica.

Causation and Pathology.—Pain in the sciatic nerve and its distribution exhibits sufficiently characteristic clinical features to entitle it to special mention, and as it is more often a neuritis than anything else it will not be out of place to consider it here. It is caused by a variety of factors, prominent among which may be mentioned tumors in the pelvic cavity or spinal canal so located as to press upon the structures that go to make up the sciatic nerve; pathological conditions of the lower lumbar or sacral vertebræ; disease processes affecting the hip joint; inflammatory processes in the nerve itself, its sheath, or those divisions of the spinal nerves which combine to form it (sciatic neuritis), set up by traumatism or the various general systemic toxæmias; adhesions between the nerve and its sheath resulting from antecedent inflammation; excessive irritability of the nerve centers in the lumbar cord, such as is sometimes met with in general or sexual neurasthenia; and possibly rheumatic infection.

It has been questioned upon entirely logical grounds whether a true sciatic "rheumatism" is ever encountered, but in many cases the clinical evidence points to the presence of this infection so emphatically that it does not seem justifiable to exclude it from the etiological category without more positive proof of its non-existence than has transpired up to the present time.

Sphere of Usefulness of Dry Hot Air.—A correct comprehension of the etiological factors present in a given case is most helpful from a therapeutical standpoint, and a little vigilant investigation will usually suffice for its acquisition. The cause of a sciatica, rather than the sciatica itself, should constitute the

main point of attack. If it is an intra-pelvic tumor the sciatica will, of course, not be susceptible of anything but temporary removal until the exciting condition has been disposed of, and in the management of this variety of sciaticas, dry hot air has very little part. In the management of the others, however, it plays a rôle of varying but always considerable importance, and its effects are both indirect and direct.

Its indirect effects are manifested in the sciaticas which are caused by such diseases as arthritis deformans, general systemic toxæmias, etc., which are susceptible of being influenced happily by the body dry hot air application, the sciaticas disappearing as the primary condition improves.

Its direct effects are manifested in those sciaticas which are generally looked upon as rheumatic, those of traumatic etiology, etc., where the pathological processes are confined to the nerve itself or its immediate vicinity, and are susceptible of being influenced by the local application.

Its use in the first-mentioned class of sciaticas will be therefore its use in the disease causing them, for the description of which the reader is referred to the sections treating of those diseases; its employment in the last-mentioned variety, or those conditions in which its direct effect is useful, is all that will be mentioned here.

Illustrative Case.

The case following is one of the so-called sciatic "rheumatisms" and shows of what dry hot air is capable when used in connection with appropriate internal medication.

Mr. M. T. M., seventy years of age, consulted me September 24, 1898. He had suffered constantly with sciatic rheumatism for the preceding four years. The exacerbation of the pain produced by bending the hip joint was such that he was obliged to ascend a flight of stairs one step at a time, and the pain was in evidence most of the time when at rest. He had tried various methods of treatment, under both professional and lay guidance, with no satisfactory results.

I treated him with the usual drugs, including salophen, for a few weeks with very slight benefit, and then administered local dry hot air applications in conjunction with gram doses of

salophen three times daily. Ten minutes after the first treatment was commenced the constant throbbing pain ceased. At the conclusion of the séance he was able, for the first time in many months, to place the foot belonging to the infirm leg upon the opposite knee to lace his shoe, and to walk downstairs without pain or stiffness.

Two days later he returned for another dry hot air treatment, reporting that he had felt a few slight painful twinges that morning, but nothing else since the first application, except when ascending a flight of stairs.

Two days after he called again by appointment, reporting that he had had no pain at all since the preceding application, and that friends whom he met on the street were remarking that he "didn't walk lame any more." Pain was provoked by extreme flexion of the thigh upon the body, but by no other manipulation. A local dry hot air application was administered and the patient directed to return in a week anyway, and sooner if symptoms returned.

At the end of a week he returned and reported having had no pain or stiffness of any sort or degree since the preceding treatment. Leg was movable in any direction and to any normal extent, and no pain was provoked by manipulation of any sort. Had been accidentally wet through twice since his last visit and been unable to change his clothing for some hours afterwards, but this event, which would have formerly been the cause of severe symptoms, had been followed by no unpleasant sequelæ. Dry hot air was once more administered and patient discharged, with instructions to call again immediately if any more trouble appeared, which he promised to do. Ten months afterwards he was still well, but I then lost track of the case and do not know his present condition. It is reasonable to suppose, however, that he would have called again had his trouble recurred.

Treatment.

Sciatic Rheumatism.—The treatment of the early stages of what we will take the liberty of still terming "rheumatic" sciatica should be the same as that of rheumatic inflammation anywhere, viz., rest, local dry hot air applications to the affected hip as often as the pain returns severely and once daily thereafter until the attack has ended, and some salicyl compound, and it has seemed to me that salophen usually gave better results in this situation than any of the others. The body dry hot air treatment every two or three days is always very helpful

in this condition through its influence upon general metabolism, but the vast majority of cases get well without it.

Sciatic Neuritis.—The management of true sciatic neuritis not dependent upon gross surgical lesions, is practically the same as when neuritis occurs anywhere else, except that drugs are useful only as pain-relieving agents as far as the lesion itself is concerned; rest of the affected leg is rather more frequently called for, and the general dry hot air application two or three times weekly constitutes an important element, as do also the other forms of physical therapeutics. In many cases the disease will not yield until the last-mentioned agents have been added to the regimen.

Electricity.—For recent cases the static brush discharge for twenty or thirty minutes, or the wave current localized over the nerve back of the trochanter for the same length of time, once or twice daily until the acute stage has subsided, does good service.

For the chronic cases, long, thick sparks over the course of the nerve, or counter-irritation with the massage roller or brass ball electrode, may be alternated with the wave current every day or two. Sparks must be applied cautiously, as they will aggravate the trouble if used too soon, and some cases will be aggravated by them at any stage. In chronic sciatica, however, judiciously chosen and applied static modalities are of more value than any other measures with which I am acquainted, excepting dry hot air and vibratory stimulation. The immediate relief of pain which usually follows static and thermal applications in these cases is one of the happiest of therapeutical experiences. The tonic action of Franklinism upon the system at large is strongly in evidence under these conditions.

Opinions vary as to the advisability of using the continuous current in acute sciatica, and, as a matter of fact, when dry hot air, mechanical vibratory stimulation, or static, are available it will seldom have to be considered at all. The usual immediate relief of pain due to its application is unquestionable, but this is frequently followed, after some hours, by an aggravation of the same. In cases where these agents cannot be used, how-

ever, and even in some cases where they can, the continuous current is useful, and may be administered as follows:

The positive pole should usually be applied, stabile, over the point of exit of the nerve from the pelvis if the lesion is outside of this structure, and over the lumbar and upper sacral regions if the lesion is within it, and the negative, labile, over the course of the nerve as far down as the pain extends. This usually means clear to the toes, and the current strength should be from five to fifteen milliamperes, according to the patient's tolerance, for from ten to fifteen minutes. Stronger currents are likely to produce irritation enough to aggravate the symptoms. Very rarely, in acute cases, but more frequently in chronic, the reversed polarities give better results, both as to sedation and permanent benefit. It can be ascertained which only by trial.

The rapidly-interrupted, magnetic-induced current from the long, fine-wire coil acts powerfully as a sedative in this condition, but rarely accomplishes much else.

It should be remembered that in some cases of this disease any application of any electrical current will make the subjective condition worse at any stage of the trouble, with the exception of the static wave, which I have never known to cause, or heard of causing, anything but benefit. It is needless to say that when such a case is encountered, electricity should be kept religiously away from it.

Mechanical Vibratory Stimulation.—One of the most useful of all of the elements of physical therapy in the treatment of sciatica, is mechanical vibratory stimulation. It is one of the newer therapeutical measures, hence its actual position as regards value is yet to be determined, but the enthusiasm with which its advocates commend its virtues indicates that it possesses enough remedial power to insure it a place of high rank in the therapeutics of the near future. The writer has accomplished with it some results in sciatica that he is satisfied could not have been attained by any other means, and believes that its scientific, rational employment will very greatly increase our power to overcome this sometimes most obstinate affection. For information regarding the theory and practice of its em-

ployment the reader is referred to " Vibratory Stimulation," by the late Professor M. F. Pilgrim, and published by the Lawrence Press of New York City, the first publication upon the subject and a thoroughly reliable treatise.

In what is looked upon as true rheumatic sciatica, very little use will be found for vibratory stimulation, but in the other varieties the writer is prepared to maintain that it constitutes a most valuable adjunct.

Immobilization.—Confining the patient to his bed and splinting the affected leg for several weeks, thereby suspending its function, is a measure that has sometimes been recommended, and which may be tried in cases that resist the measures outlined above. The writer has never used this plan and is not, therefore, competent to discuss it.

Operative Interference.—The assistance of surgery will have to be invoked in many cases of sciatica which are due to the presence of intrapelvic or intraspinal neoplasms, but nerve stretching or other operative measures involving the sciatic nerve structure itself are rarely, if ever, called for in primary, uncomplicated cases of this disease, when the above remedial measures are available.

LITHÆMIA.

Definition of Term.—This term is sometimes used as a synonym of gouty diathesis, but the two conditions are not identical. The latter term should be restricted to the condition occurring in persons who inherit the tendency to impaired trophic nerve function, which results in suboxidation of metabolic products and which usually goes on to eventuate in paroxysms of true articular gout; while the former should be used to indicate a condition in which the presence of suboxidation products in the system is the result of errors in living in one whose heredity is untainted, and in whom the condition has not existed long enough to induce the characteristic constitutional phenomena of true gout.

Etiology, Pathology, and Clinical Characteristics.—Although the symptomatology of these two classes is nearly, if not quite, identical in their early stages, yet the prognosis and

response to treatment are very different. In lithæmia the natural tendency is toward recovery, and if the exciting causes, viz., excesses and faulty habits of life, are corrected, the condition will disappear. If, on the other hand, the patient persists in his errors, the condition may go on to the production of true gout, or one of those diseases so closely allied to it—diabetes mellitus or obesity; or he may become a neurasthenic wreck. A surprisingly large proportion of the neurasthenic cases encountered are traceable to impaired function of the trophic nerve centers dependent upon a systemic toxæmia induced by intestinal indigestion, or inability to do the work forced upon them of some other of the viscera concerned in the nutrient function—in short, the presence in the body of an intolerable amount of the products of suboxidation.

In the true hereditary gouty diathesis the tendency is not towards recovery, but towards a gradual increase in the frequency of occurrence and severity of the symptoms. The vitality of the trophic centers is constitutionally impaired, and however careful the victims may be in their habits of living, the majority of them become chronic invalids and die of nephritis, apoplexy, or some other gouty *finale,* after months and sometimes years of suffering.

As far as we know, however, the neuralgias, dyspepsias, hemorrhoids, chronic bronchitis, etc., of lithæmia and the true gouty diathesis, in its early stages at least, are due to the selfsame direct etiological factor, suboxidation. Confirmatory of this view is the fact that all the measures which have ever been productive of anything like permanently satisfactory results in these conditions have had increase of metabolism, *i. e.,* oxidation, as one of their prominent effects, or decrease of the matter ingested, which would put an undue burden upon the oxidative capabilities of the organism, as their object. Regulation of diet, combined with judiciously-directed exercise, has always been the sheet anchor in treatment.

Chemical experiment and clinical experience have also shown that increasing the alkalinity of the blood renders more soluble and hence more susceptible of excretion, the suboxidized products present in lithæmic subjects, and the alkali-lithia prepara-

tions have gained reputation in the treatment of the condition because of their capacity for accomplishing this end. The large amount of water which accompanies their administration also facilitates removal of the offending matters by its solvent influence in the tissues of the body, and its diuretic effect upon the kidney.

Therapeutic Indications.—From the foregoing it will be seen that the management of lithæmia resolves itself into the employment of measures tending to secure, first, a limitation of the nitrogenous matter ingested; second, an increase in the oxidation processes whereby waste products retained in the blood and tissues may be rendered more susceptible of excretion; and, third, a rehabilitation of the trophic nerve centers, functional impairment of which has maintained the derangement of metabolism throughout the organism.

Diet.—The first object is obtained by regulating the ingesta according to well-known rules, and the daily ingestion of plenty of pure water, at least a quart per day, should constitute an unvarying element in the management of every case.

General Dry Hot Air Application.—For the attainment of the second there is no measure equal to the body dry hot air treatment, either in efficiency or rapidity. We have already noticed its powerful influence in stimulating metabolism, and in rehabilitating, reconstructing, and invigorating an exhausted nervous system, hence a mere mention of the facts will suffice here. One other effect of the body dry hot air treatment which merits consideration here, however, has not been specifically referred to before, and that is its power to increase the alkalinity of the blood. As noted previously, increase in alkalinity is very helpful in transforming the insoluble products of imperfect oxidation into soluble forms which are susceptible of excretion. This it accomplishes through the profuse perspiration induced, which is strongly acid in reaction. The rapid withdrawal of such a large quantity of fluid from the body also plays no small part in the general metabolic stimulation excited, by reason of increase in volume and rate of the circulation in all the tissues of the body. In this connection it acts the same as general massage, but much more profoundly.

Elevation of the body temperature is rarely, if ever, present in uncomplicated lithæmia, hence the technique of the body treatment is simple, and has been fully described in the section devoted to that subject. Modification will be required only with those patients whose arteries have become atheromatous, and then only to the extent of using a less intense degree of heat and running it up more slowly for the first three or four séances. The degree of heat eventually attained should be at least 350° F., and the time period of the application should depend upon the pulse acceleration and the degree of hyperthermia induced.

Electricity and Hydrotherapy.—Other physical measures which are efficient in removing the primary pathology of lithæmia are the static electrical modalities, hydrotherapy, and the radiant heat bath, but, in the writer's experience, no one of them has equaled body dry hot air applications. The static modalities are of very great assistance in combination with it, however.

Drugs.—The mineral waters and salines are the best agents to employ against the constipation which is usually present, and this condition should invariably be looked to. Free action of the bowels is of the utmost importance in lithæmia.

Immediate symptoms, such as neuralgia, indigestion, irritable bladder, etc., will rarely call for special attention after the first week of dry hot air treatments, but when they do their management does not differ from that ordinarily applicable.

Exercise.—Judiciously-regulated exercise is a necessary accompaniment of any management of this disease.

Gout.

It is not inappropriate in this connection to say a word about the use of dry hot air in true gout. True gout is not common in this country, and the writer has had very little experience with the agent in this disease. Our transatlantic colleagues see a deal of it, however, and some of them speak highly of the use of dry hot air in its treatment. Walsh, of Edinburgh, Scotland, has used it a good deal, and reports as follows:

"The present writer has witnessed remarkable results, fol-

lowing the application of the superheated air in gouty cases. It will control even acute gout, and in one case an incipient attack in the great toe was treated with so much success that the patient, a stockbroker, was enabled to keep his engagement at a shooting party next day. That result will speak volumes to all who are familiar with acute gout. In advanced and chronic cases the restoration of movement and return to health has often been of a most striking nature. Under the superheated air uratic deposits and enlarged bursæ often vanish.

" A somewhat extensive experience has convinced the present writer that the Tallerman method yields curative results in gout that cannot be approached by other therapeutic measures."

It would seem that the physiological action of dry hot air, especially of the general application, was particularly well adapted to remove the pathological conditions obtaining in true gout, and the hope that it may prove to be of value upon further acquaintance seems justified by what is known of its practical clinical effects.

NEURALGIA.

In the treatment of no condition is the correct diagnosis of causative factors more essential than in that of the various neuralgias. As the scope of this article does not include diagnosis, the truth of the above statement will merely be indicated by calling attention to the fact that neuralgia may be provoked by a variety of causes, prominent among them being general debility, resulting in impaired nutrition of certain nerve trunks; the presence of abnormal substances in the blood, as exemplified by the neuralgias accompanying lithæmia, plumbism, the excessive use of tobacco, and the infectious fevers; certain degenerative processes in the spinal nerve-tracts; degenerative changes in the nerve trunks themselves, and pressure from tumors. Another rare cause is disease of some of the internal organs, which produces the sensation of pain in the remote distribution of a nerve trunk, the pain-conducting fibers of which are so situated in the cord as to be susceptible of influence by pain impulses traversing the nerve supply of the affected organ, the so-called " referred pains."

Treatment.

Dry hot air enters the problem in two ways; it is efficient in removing some of the primary causes in the form of the body treatment, and in mitigating the local condition in the form of the local application. I will say here that, as the agent cannot be applied directly to the head, it is useful in cephalalgia only when this is dependent upon some systemic condition which is amenable to the influence of an application to the general body surface.

General Dry Hot Air Application.—In the neuralgias of general debility, body dry hot air treatments are of transcendent value. The pains usually lessen, and sometimes disappear entirely during the first séance while the patient is in the apparatus, and not infrequently the removal is permanent. Its influence in this situation is, of course, due to stimulation of the trophic processes throughout the body, and the determination of a large quantity of blood laden with nourishment to the starving nerve.

Neuralgias, due to the presence of abnormal substances in the blood, will nearly always yield temporarily to local treatments when in accessible situations, but their radical removal will usually demand the body application. This acts, of course, through its power of inducing rapid elimination, as well as sedation of nerve irritation and acceleration of normal metabolism. Enough work has not yet been done with it in the neuralgias accompanying the infectious fevers to make reliable conclusions possible, but the data now at our command would indicate that it possesses some usefulness in this connection.

Local Dry Hot Air Application.—When the painful part is accessible, as the intercostal nerves for instance, and the primary cause is a general debility, the local application will almost always relieve at once, and sometimes the result is most happy as to permanence. The writer has seen an intercostal neuralgia of fifteen years' standing entirely cured by three local dry hot air treatments.

This measure will sometimes also afford temporary relief in

pain affecting the distribution of nerves pressed upon by tumors, but only removal of the primary cause, of course, will result in permanent cure.

The technique of both body and local treatments in neuralgia is simple, and has been fully described in Chapter III.

Electricity.—The electrical modalities, especially those derived from the static machine, vie with dry hot air in the treatment of neuralgias, and in some situations, as about the head, supplant it entirely in most cases. Where it is appropriate, much greater convenience of administration makes it preferable to hot air, and it is always of value in connection with it. Temporary relief of pain, at least, can almost always be secured by electrical applications, and cases of even the intractable "tic-douloureux" have been reported as cured by them. The writer has never seen a case of true "tic," however, in which anything short of resection of the nerve or total removal of the gasserian ganglion afforded complete and permanent relief, but it is sometimes a matter of great comfort to be able to afford the sufferers even short respites without operation. Dry hot air has so far scored no successes in this affection.

Drugs.—The medicinal treatment appropriate to the various primary conditions causing neuralgias should accompany the physical measures, and the final result is much hastened thereby; neither alone will accomplish the results attainable with both together. As indicated previously, surgery will also have to be called upon at times to extirpate exciting causes, as tumors, etc.

Myalgia.

This affection is really a neuralgia affecting the nerve fibers ramifying in a muscle. It is usually due to systemic toxæmia of some sort, and the treatment is the same as for neuralgia in other situations. The static wave current or spark will usually alleviate the pain more rapidly and thoroughly than any other measure, and dry hot air applications, both local and general, stand pre-eminent among the means for removing both immediate symptoms and primary causes.

VARICOSE ULCERS.

Varicose ulcers are directly due to impairment of the local nutritive function, but this, in turn, is due to constitutional debility or degeneration of some sort, and atheroma, the gouty diathesis, and lithæmia play an important part as predisposing conditions in many cases. The direct etiological factor is most frequently traumatism, the effects of which the crippled circulatory function is unable to repair.

Treatment.

Local Dry Hot Air Applications.—Local applications of dry hot air constitute one of the most effective single measures known for the local management of the condition, and, in ordinary cases, will effect a cure in from three to six weeks. The cure will not usually be permanent, however, unless the constitutional conditions upon which the local lesion depends are also removed or lessened.

The technique is that usual to the local treatment, except that the temperature rarely need be higher than 300° F. The frequency of application will depend entirely upon how the sore responds. At the beginning it should be applied every other day. If no improvement is noted at the end of ten days it may be increased to every day. When an appropriate constitutional treatment has accompanied the local dry hot air applications, the case will be a rare one which does not exhibit marked improvement in three weeks.

General Dry Hot Air Applications.—It is always wise, and sometimes necessary, to administer the body treatment once or twice weekly to patients suffering from varicose ulcers. We have already considered the different phases of its physiological action, hence it is only necessary to recall the constitutional etiology of varicose ulcer in order to appreciate the manner in which the body treatment is beneficial.

Electricity.—The electrical modalities alone are of great assistance in the management of the condition under consideration, but, in combination with dry hot air, their effectiveness is doubled.

The negative pole of the galvanic battery, applied directly

to the ulcerating surface with from two to ten milliamperes of current according to the patient's tolerance, is extremely effective in producing repair of the local lesion. Enough current to cauterize should not be used. Electrolysis is what does the work, and cauterization will but hinder progress.

The static wave current localized upon the sore is nearly as effective as galvanism, and possesses the advantage of exerting a marked constitutional influence for good. The brush discharge is also very effective, in some cases appearing to do even better work than the wave or galvanism. Sparks to the ulcer enjoy something of a reputation as a curative measure, but the writer has seen ulcers that were attempting to heal repeatedly break down again under their application, and has abandoned them entirely in this connection. The high frequency current bids fair to prove useful, but it has not yet been used enough to make reliable conclusions possible.

Drugs and Surgical Dressings.—The administration of appropriate drugs for their constitutional effect, and the application of appropriate antiseptic dressings, should always accompany the physical measures, but strapping or other stimulating measures are entirely uncalled for.

OTITIS.

Hopkins, of Cleveland, O.; Beck and Oaks, of Chicago, Ill.; Schloss, of San Francisco, Cal.; Sverzhevsky, of Moscow, Russia, and others have reported very good results from the use of dry hot air in affections of the ear. The author has had no experience with the agent in this situation, and the following is extracted from one of Dr. Hopkins' excellent articles upon the subject. The case reported below had remained well for five years at the time of publication, and was treated with a very crude apparatus, instead of the modern finished product described in the chapter upon "Apparatus."

"The patient, John L., aged fifty-three, a carpenter, with excellent family and personal history, has never been seriously ill, but has had nasal catarrh for fifteen years, and gradually increasing deafness for ten years.

"Examination revealed a typical case of hypertrophic

rhinitis. The watch tick could be faintly heard with the watch in very close contact with the left ear. The tick could be heard to a distance of three inches from the right ear. The left ear was selected for the test.

"Diagnosis: Chronic catarrhal otitis media, with sclerosis and displacement of the tympanum, anchylosis of the ossicles, slight dilatation of the Eustachian tube, and some labyrinthine involvement.

"The diagnosis was confirmed by two colleagues of reputation as aurists before treatment was instituted. Regular, systematic treatment, continued for two years, before this experiment was made, had scarcely stayed the progress of this disease.

"Treatment: The ear was thoroughly cleansed with alcohol for several days before treatment was instituted. The patient was then seated in a comfortable chair, the ear examined and found perfectly clean. Narrow strips of dry gauze were placed into the ear, and a large pad of dry gauze placed over the ear. The ear was then covered with a canvas sleeve hot air conductor, and a current of air sent into the canal at a temperature which gradually attained 400° F.

"The temperature was easily borne, if gradually increased, until a high point was reached; the only discomfort attending the treatment arising from a severe headache which followed it, but which was promptly relieved by a dose of codein.

"Following the hot air treatment, the Eustachian tube was always inflated with a warm stimulating vapor from a Globe nebulizer, vibratory massage with the nebulizer completing the treatment.

"The patient was not allowed to leave the office for a half-hour after treatment, and the ear was tightly packed with warm cotton before he went out.

"The nose and pharynx received appropriate treatment with antiseptic washes, etc.

"Treatments were continued on alternate days for three months, at the end of which time he could hear the watch tick distinctly at thirty-four inches, and surprised his friends by invariably replying to their whispered references to him.

"The right ear was then similarly treated, and in ten weeks an equally good result was secured.

"Examination showed that the ears were normal in appearance. The patient was discharged January 6, 1897, and careful tests made at frequent intervals since have shown no tendency to recurrence.

"As to the philosophy of such a cure by this agency, little can be said at this time, but it seems certain that the intense heat

stimulates the circulation through the blood supply on the posterior side of the manubrium, causing absorption of the articular deposits, removing atrophy and relieving the rigidity of the tensor tympani. The ossicles lie so near the surface that they receive the full benefit of heat applied to the tympanum, and adhesions between portions of the ossicular chain and the adjoining bony walls of the middle ear are readily removed.

"Naturally, much better results are secured in the same period of time in hypertrophic cases than in those characterized by hyperplasia; but many cases of the latter type, which would ordinarily have been regarded as hopeless, have gradually improved under this treatment until marked benefit was secured.

"As to the results which may reasonably be expected from the judicious and skillful employment of the agency with good appliances in cases of chronic catarrhal otitis media, it may be said:

"(1) That as an exclusive treatment it is rarely of much value in bad cases.

"(2) That when indicated and judiciously employed, in conjunction with other measures of recognized value, it will give results which would be utterly impossible without its aid.

"(3) That when employed with care it is absolutely safe unless contra-indicated.

"(4) That it is of little value in old subjects who have extensive labyrinthine involvement.

"(5) That it stimulates absorption of articular deposits, removes atrophy, and relieves rigidity of the tensor tympani.

"(6) That it acts more favorably on the ossicular chain than on many other articulations, because of the exceptional proximity to the surface.

"(7) That arteriosclerosis and serous effusions into the tympanum are usually contra-indications, and always contra-indications to the inexperienced operator."

The technique of dry hot air applications to the external auditory canal is fully described in the appropriate section of Chapter III. Dr. Hopkins speaks of the use of additional remedial measures as follows:

"Every case must be treated as a whole. He who neglects

the appropriate treatment of the naso-pharynx is doomed to disappointment.

"Antiseptic washes must be used. All abnormal conditions must be rationally treated. Constitutional measures, when indicated, must not be neglected. Inflation of the Eustachian tube with a warm, stimulating vapor from some good apparatus like the Globe nebulizer is usually imperative.

"It is well to practice Eustachian inflation and vibratory massage of the middle ear with medicated vapor from the nebulizer after each hot air treatment, being particular that the vapor is warm. A warm vapor is easily secured by connecting the compressed air heater in service with the nebulizer, sending the compressed air first through the heater and then through the nebulizer.

"Careful attention to all details brings most gratifying success in the form of gradually and steadily improved hearing and gradual disappearance of tinnitus.

"A single detail neglected may cause absolute failure."

CHAPTER XI.

MISCELLANEOUS CONDITIONS.

Nervous Debility and Exhaustion.

The condition meant here is the neurasthenia due solely to excessive nerve strain, and is encountered in individuals who have overworked, and sometimes in women who are passing the climacteric.

The object to be obtained by treatment is the reinvigoration of nervous tissue, which has become exhausted to an unmanageable degree of irritability and functional impairment, by the production of new cells which are capable of normal function. This can only be done by calling into activity the metabolic functions concerned in nutrition. As we have seen, the body dry hot air treatment stands pre-eminent as a stimulant to metabolism, and would seem to be an ideal measure for the removal of nerve debility of any degree; experience proves it to be very useful in this field. When the patient comes under treatment before the debility has become an exhaustion, it is not necessary for him to stop work entirely even. One or two body treatments a week with a strychnia tonic will usually restore him to health in short order.

When the initial condition has been neglected or inefficiently treated, however, and the point of exhaustion has been reached, the problem assumes a different aspect both as to management and duration. The most prominent symptoms now exhibited are insomnia, more or less melancholia usually, inability to fix the mind upon any one subject for any length of time, physical exhaustion upon slight exertion, all sorts of aberrations in the sensory sphere, and gastric and intestinal indigestion.

The last-mentioned phenomena, primarily due to impairment of the nerve centers controlling the digestive ferment-producing glands, react upon the organism by throwing into the

blood current imperfectly metabolized substances, thereby maintaining the depression of the central nervous system.

Usually the first thing to do now is to secure a complete change in the patient's surroundings and mental habits, by removing him from his home and placing him in an environment which will admit, as nearly as possible, of entire freedom from care and undue physical and mental exertion. Supply him plentifully with plain, nutritious, easily-digested food, selected according to the idiosyncrasies of the individual case, and give him a body dry hot air treatment two or three times a week. A judicious amount of exercise is also very beneficial in most cases.

Static and high frequency electricity are most useful, in combination with dry hot air, in all grades of neurasthenia, and their beneficial influence is not looked upon as due entirely to suggestion by those who have used them very extensively. The wave current, localized over the solar plexus in the morning, and over the spine in the evening, and auto-condensation three times weekly, are the most useful of the modalities. When the nervous condition has improved some, static sparks may be applied over the spine and general surface of the body, preferably in the morning. On the days when dry hot air is administered, one of the electrical treatments may be omitted.

The combination of these three measures, with galvanization of the brain and spinal cord twice weekly, and regulation of the gastric and intestinal functions, has given me more satisfaction in the treatment of uncomplicated neurasthenia than any other measure that I have ever used.

The electric arc and incandescent light baths are very highly spoken of by Kellogg and others, and the physiological action of radiant heat constitutes a logical and seemingly strong evidence favoring its employment in this condition. Its efficiency as compared with other physiological methods of management, however, is a matter to be decided in the future.

General Debility and the Convalescent State.—It may not be amiss to mention in this connection that recovery from any simple general debility, and convalescence from the acute exhausting diseases, such as pneumonia and typhoid, and which,

especially in the latter, is sometimes greatly prolonged, may be hastened in the most gratifying manner by the use of body dry hot air treatments, electricity, and mechanical vibratory stimulation.

Pulmonary Tuberculosis.

The only therapeutical measures that have been proven to be of substantial benefit in consumption are those that improve the general condition and increase the nutritional processes of the patient. As we have seen, the administration of one or two body dry hot air treatments a week is very efficient for this purpose, and it is my belief that this measure will play a not unimportant part in the treatment of this disease in the future. The establishment of tuberculosis sanitaria throughout the country, and for that matter throughout the world, is attracting daily more and more favorable attention, and the realization of this most desirable method of handling the disease is probably not far away. In institutions of this character, where the environment of the patient, his daily habits, etc., would be carefully arranged and directed so as to secure the most favorable conditions possible for his improvement, dry hot air could be administered so as to utilize all of its powers.

I have not subjected many patients to this treatment, because the climatic conditions obtaining in this region are among the worst possible for such cases. I always send them away immediately, when they can go. Some are not able to go, however, and then we have to do the best we can under the circumstances.

Although dry hot air has not cured any of the patients that I have had under observation, yet it has done a great deal in the way of increasing strength and improving the general condition. The appetite and assimilation of food have been improved, whereby a diminution of the rapidity of progress of the disease has been secured and life prolonged. I have seen a patient who was so weak when brought under treatment that she would consume half an hour in ascending a flight of twenty stairs, and who could accomplish scarcely more than that many steps on the level without sitting down to rest, improve in a month to such an extent that she was able to ascend two flights

of stairs without stopping, and could go off and take trolley rides alone by herself. Dry hot air appreciably lessens the cough, the patient sleeps better, feels better, and usually gains some in weight. After the first period of improvement, however, the patient begins slowly to fail again, and continues steadily so to do until the usual termination obtains. These observations apply only to advanced cases, as, for reasons previously stated, I have never subjected an incipient case to the treatment.

It has been suggested that the improvement observed was due to psychical influence, but I do not consider this explanation to be the true one. It is an undoubted fact that a consumptive will improve generally for a short time under any new line of treatment, but the improvement does not continue steadily for from six to eight weeks and is not accompanied by gain in weight, lessening of cough and expectoration, etc., as is the case when body dry hot air treatments are administered. The improvement dependent upon psychical influence usually, in my experience, has lasted about one and rarely more than three weeks, after which the patient's condition is all at once as bad as ever again. When the decline begins again after the improvement from dry hot air treatments, it is slow and gradual, showing constantly decreasing systemic resistance, and sometimes it requires two or three months to reduce the victim to the condition which he was in before beginning treatment. Judiciously and thoroughly administered body dry hot air treatments are worthy of extended trial under favorable climatic and hygienic conditions in pulmonary tuberculosis.

The local application of this agent is most satisfactory for dealing with the secondary pleurisies of tuberculosis, and a certain amount of general benefit follows its use. At first sight it would seem as if we might expect the same benefit to follow its use in consumption as in pneumonia, but experience does not bear out the inference. We have in phthisis a condition similar to that obtaining in central pneumonia, as far as the bulk of the pathological tissue is concerned, viz., the foci of infection are separated from the dry hot air apparatus by layers of functionating air-cells. Across these, as in central

pneumonia, it is of course impossible to conduct the heat; hence the infected tissues cannot be reached. The heat can easily be conducted to the pleuræ, however, and the rapid and satisfactory manner in which the local application extinguishes these painful and debilitating secondary outbreaks of the infection, is a source of great comfort to the physician as well as to the patient.

X-light passed through the affected lung tissue three times weekly has apparently produced some extremely good results in tuberculosis. Rudis-Jicinsky has reported curing sixteen out of a series of twenty cases of incipient tuberculosis pulmonalis by this method, and his cases had remained well two years after, as far as could be observed. Grubbe, Burdick, and others also speak most encouragingly of its use; still other observers have not had such a large percentage of cures. The author has treated three cases with X-rays. One of them improved for a while; another continued to grow slowly worse, although I believe that the rapidity of the progress of the disease was checked somewhat; the third died, showing apparently no effect whatever from the rays. The favorable results that have been attained, however, make it worth while to give X-light a trial, however small the percentage of benefit that might be obtained.

The inhalation of ozone, generated in a special apparatus from the static electrical current, is spoken of most highly by some observers, but it has not yet been used sufficiently to make a reliable judgment possible. The writer has not been able to convince himself that appreciable benefit followed its use in cases under his observation.

In France and England the high-frequency electrical currents have been reported as giving most excellent results and it is to be hoped that the investigation of their powers in this disease, which is now being somewhat extensively carried on, will justify the hopes that have been raised by these reports.

The general nutritional applications of static electricity, cod liver oil, and other drug tonics, chief among which may be reckoned strychnia, as well as every other known means of increasing vitality and bodily vigor, should be used in the

treatment of tuberculosis. As suggested previously, it is probable that consumptives will in the near future be taken care of in specially arranged and located sanitaria, where all of these measures can be applied in combination and to the greatest advantage, and not until then can we hope to see very satisfactory curative results, in a large proportion of cases, follow the use of the remedial measures known at present.

Chronic Bronchitis.

Another disease of diverse etiology. When due to general debility, as when it follows after la grippe, or to constitutional aberrations, as lithæmia or the gouty diathesis, body dry hot air treatments are very effective in removing it. The local application, administered as for pneumonia, also possesses considerable value in its treatment. The technique of either treatment requires no special modification. The general tonic, corrective, and eliminative influence of the body applications are well supported here again by general applications of static electricity, the wave current to the spine, sparks to the spine and chest, etc., but the inhalation of ozone has proven to be something of a disappointment to most of us. It is of benefit in some cases, however, and should always be tried if a patient is not responding well to other measures.

The ordinarily-indicated drugs should always accompany the physiological measures. In this, as in rheumatism and several other diseases that have been noted, the physiological measures render the drugs active by so influencing the organism as to remove or lessen conditions that cause medicinal agents, unaided, to be inefficient. Neither alone will do the work that can be accomplished by both together, and non-tuberculous chronic bronchitis is sometimes intractable enough to require all the resources at our command for its removal.

Fibrous Anchylosis.

It has been stated that this condition, when occurring in the larger joints, was not amenable to the corrective influence of dry hot air; this statement was erroneous. One of the writer's early cases was a fibrous anchylosis of the knee, occurring in a boy of eleven years of age, resulting from five weeks' con-

finement of the joint in a splint applied for a fracture of the femur immediately above the condyles. He had been etherized when the fracture was put up, and the after-effect was so prolonged and severe that his parents were unwilling to have the experience repeated. The joint was exquisitely sensitive, however, and the adhesions could not be forcibly broken up except under an anæsthetic. I administered fourteen local dry hot air treatments, following each with a few minutes of passive motion, the excursions being susceptible of a little increase after each successive séance, and the knee regained its normal mobility. Subsequent experience has shown that the body treatment is of assistance in combination with the local application in removing this condition. Several other observers have reported cases of fibrous anchylosis in which this agent effected a satisfactory termination, and its favorable influence over the condition is established beyond question.

The local treatment should be applied every day for a week, and then every other day until recovery has taken place. Five or ten minutes of passive motion should follow each treatment, the joint being flexed as much as possible without causing the patient undue suffering. If troublesome inflammatory reaction follows this manipulation, the dry hot air should follow instead of precede the stretching of the adhesions. The body treatment two or three times weekly will greatly hasten the absorption through influence exerted upon the metabolic functions.

The static wave current, static spark, and galvanism are efficient in combination with this agent in hastening the process, in the order in which they are named. Their curative power is exerted through the same channels as that of dry hot air, but here, as in some other conditions, it is much less profound, hence not so effective when used alone.

Cholylithiasis.

Dry hot air will not relieve the pain of ordinarily severe hepatic colic, and I know of nothing but morphine that will. Sometimes, however, the formation of new calculi can be prevented by the use of body treatments in combination with electricity and the administration of appropriate drugs. The

result is attained through the influence of the measures in correcting the impairment of liver function, by reason of which impairment cholesterin crystals are deposited, whereas they should normally remain in solution. The following is a case in point:

A lady, forty years old, had sustained her first attack of hepatic colic a year and a half before she consulted me. She had had several attacks since then, and the interval between them had never been more than three months. During the four months preceding her consultation with me they had prostrated her about once every four weeks. She had been given appropriate drugs and her diet had been wisely regulated, but no effect was evident upon the calculus formation. The attacks were growing more frequent and more severe. Her digestive and assimilative functions were greatly impaired, and marked general nervous debility was present. She had lost twenty pounds in weight during the preceding six months.

She was admitted to the sanitarium, her treatment consisting of body dry hot air applications three times weekly, galvanization of the spinal cord with the negative electrode over the solar plexus twice weekly, and static electricity twice daily, except on the days when dry hot air or galvanism was administered, when one of the static applications was omitted. The static modalities used were sparks to the spine, general muscular surfaces of the body, and over the liver and gall-bladder in the morning, and the wave current localized over the liver at night. She was given sodium phosphate in five-gram doses three times daily, magnesium sulphate for her constipation when necessary, and the diet was restricted to plain, easily digested food, with meat fats, pastries, and sweets carefully eliminated.

Her general condition began to improve immediately, and continued to do so for three weeks. She then began to complain of premonitory symptoms of an attack of colic, and three days later was prostrated by the worst seizure of the sort that I have ever witnessed, which lasted for three days. Her fæces were washed and fifteen calculi recovered, varying in size from that of a head of a pin to that of a pea.

She was kept under the same treatment for three weeks more and then sent home for two weeks, at the end of which time she was admitted for another course of three weeks. For the following six months she was given two weeks' courses of the same treatment at intervals of three and four weeks. She had no more attacks, and her general condition steadily improved, until at the end of that time she felt and apparently was

entirely well, and has remained so ever since, a period of two years.

None of the cases have yet been under observation long enough to demonstrate whether or not the beneficial results will be permanent, but the outlook would seem to be promising.

Gangrene.

Gangrene is commonly due to a cutting off of the circulation of the part affected, as in embolism; or extensive impairment of the nutrient function of the blood vessels supplying the part affected, as atheroma, and exemplified in senile gangrene of the extremities. The condition also obtains occasionally in some grave constitutional diseases, as diabetes mellitus.

Dry hot air treatments, both body and local, are of great assistance in combating gangrene, and, as would be expected from the character and profundity of its physiological action, the body treatment is most efficient. That the local treatment alone is capable of removing the affection most satisfactorily in some cases, however, is demonstrated by the result attained in the following instance, which was reported by Morse, in the *New England Medical Monthly* for May, 1898:

"Mr. D. Fargo, aged seventy-nine years, farmer by occupation, was attacked with gangrene (senile) in the left foot. There is nothing in his personal or family history worthy of any particular mention or having any bearing on the case. Patient, while cachectic-looking, weak, and apparently in a precarious state of health, showed no other organic trouble save the heart—lungs, stomach, liver, apparently, being normal. Urine contains some earthy phosphates, but no albumin or sugar. Patient noticed his trouble first in August, 1897. His family physician made no particular diagnosis and on that account refused treatment.

"Physical examination of the two middle toes, which were affected, revealed quite a deep ulcerative process, involving also the adjacent structures of the dorsal side of the foot. Aside from the general sloughing the toes were practically dead. Poultices, cauterization, and antiseptics proved of no avail. Amputation was out of the question, on account of the existing heart trouble (mitral insufficiency), which was quite pronounced. Then decided symptoms of blood poisoning set in. Add to this the general weakness, due to disease and age,

and it was evident that any harsh surgical procedure would almost to a certainty be followed by shock and death.

"All I could do was to dissect away the sloughing tissue and treat the wound antiseptically. The condition assumed a worse form, the leg becoming œdematous from the knee down and hyperæsthetic. Constitutional treatment was prescribed, but all to no avail. I despaired of the case and gave an unfavorable prognosis.

"Then an idea struck me—would intense dry heat not alter the local condition? I had previously investigated this agent for rheumatic and articular affections, and immediately ordered an apparatus from Frank S. Betz. On arrival of the apparatus the limb up to the lower third of the thigh was wrapped in a towel and put into the cylinder, and the air within heated gradually to 350° F. Two treatments a day were given, the temperature reaching later 400° F., for two weeks. Continuous observation proved a decided diminution of the œdema, healing by granulation of the sloughed tissues, and improvement of the constitutional septicæmic symptoms. Patient was discharged cured in two weeks, to everybody's surprise, and at the time of writing, is working on his farm."

Angina Pectoris.

The writer has treated one case of true angina pectoris with dry hot air. In this instance the cause was probably calcareous degeneration of the coronary arteries or of the aorta. When the patient came under treatment he was unable to walk half a block or go up a flight of stairs without provoking an attack, and was utterly incapacitated for performing his ordinary daily duties. After a six weeks' course of body treatments he had improved to such an extent that he resumed his business duties again. He would sometimes be entirely free from pain for two days at a time, and when it did obtain it was not severe enough to demand opiates. He then discontinued his treatment, but I still see him occasionally and he reports himself as having slowly, but steadily, improved.

I exercised the utmost care in administering the treatments to this patient, watching the heart action and subjective phenomena very closely. When the pulse had been accelerated to 110 beats per minute the pain would always begin to appear, and if the treatment was continued it would soon rise to an

excruciating intensity, compelling the patient to sit up in the apparatus. When the heat was turned off, however, the pain would begin to subside as soon as the pulse got below 110, and I soon adopted the plan of turning off the heat as soon as the pain put in an appearance, without any reference to the amount of hyperthermia induced. No alarming symptoms obtained at any time.

It would seem, from its power of influencing atheroma of the general arterial system, that the general dry hot air application would be of use in treating angina pectoris dependent upon this etiological factor, and the result obtained in this case gives color to the supposition. In view of the almost absolute lack of practical experience with it in this disease, however, and because of the characteristic effect of body dry hot air upon the circulatory system, it should be used with the utmost caution until enough experience has been gathered to make a reliable judgment possible.

Pseudo-angina is most frequently dependent upon general nervous debility or stomach trouble of some sort, and they often go hand in hand etiologically. Body treatments are usually most efficient in removing both cause and effect in combination with other appropriate measures, especially static electricity. The writer has succeeded in curing entirely patients who had suffered with the affection for five years, and who had exhausted all other known measures of therapeusis.

La Grippe.

The body treatment, applied every other day at a temperature of 350° F., will usually completely eradicate the disease in from four to eight days. The first séance will extinguish the pains entirely, and they will rarely return; the bronchial and nasal symptoms respond at once, and the prostration will have disappeared inside of twenty-four hours to such an extent that the patient can often return to his occupation at once. Comfort is secured immediately, and the slow convalescence, extending over a period of weeks not infrequently under other methods of treatment, is encountered with the utmost rarity when the affection is combated with dry hot air. The temperature usually

continues slightly elevated for a day or two. The writer can say, with a conviction born of personal experience, that the field of therapeutics offers few more delightful and satisfactory possibilities than are realized by the treatment of influenza with this agent.

Syphilis.

A few patients suffering from this affection have been treated with this agent and have responded well. Corwin reports a case of multiple syphilitic arthritis which had resisted other therapeutical measures for several months as cured in three months by local applications in combination with potassium iodide internally. Relief of pain was immediate and permanent.

The body treatment is the application that should be used generally in this disease, and mercury or potassium iodide, according to indication, should be thoroughly administered in combination therewith. The general tonic effect of this measure, exerted through its influence upon assimilation, metabolism, and elimination, affords good grounds for the hope that its addition to the therapeutical armamentarium of syphilis will enable us to shorten materially the period of time during which it is now necessary to keep these victims under treatment in order to effect a cure.

Alcoholism.

A glance merely at the physiological action of body dry hot air applications will demonstrate their exquisite applicability to ordinary cases of alcoholism. I know of no agent that will so effectually allay the nervous symptoms, produce such refreshing sleep, and place the patient so quickly upon his feet.

The induction of the phenomena of over-stimulation is sometimes very easy in these cases; the pulse and temperature go up very quickly, and the patient must be watched very closely during the first and second treatments. A fifteen-minute séance, with a temperature of 275° F., is sometimes all that it is judicious to administer, and the writer has seen a pulse of 160 beats per minute and an increase of 3° F. in the body tem-

perature follow even this mild application. In other cases, on the other hand, the séance will have to be prolonged; the idiosyncrasies of each individual patient will have to govern on these points. Regulation of the ingesta and the administration of drugs should accompany the thermal applications as indicated.

The radiant heat bath has been extensively and successfully used in the treatment of alcoholism by Crothers, who speaks of it in most favorable terms. It promises to play an important part in the future therapy of this condition.

Gynecic Affections.

The use of general dry hot air applications in acute infections of the adnexa has already been discussed in the section upon peritonitis, and it is only necessary to say further that the results therein suggested have been confirmed by many operators, both in this country and abroad.

Polano, Dutzmann, and Burger, of Vienna, Austria, have secured most gratifying results in some cases of old inflammatory processes involving the female pelvic structures of from six months' to nine years' standing, as regards both subjective and objective improvement. They consider that the application affects the exudate as does a hot cataplasm, only far more energetically. In one case in which the exudate was "as hard as a stone," the resultant softening was so rapid that the proper time for incision passed unnoticed and the pus ruptured spontaneously through the umbilicus and into the bladder.

When we recall that the human organism usually rids itself of disease processes solely by an accentuation of normal metabolic processes, the logic of its employment in conditions such as the above becomes quite clear; it is undoubtedly destined to become an element of importance in the management of gynecic inflammations.

The pain of dysmenorrhea during the attack can ordinarily be greatly relieved and sometimes entirely removed by the use of the body treatment at the time. I have known functional dysmenorrhea of long standing to be relieved for months after a course of body treatments given for some other affection.

When the trouble is due to structural peculiarities or organic pathologies of the pelvic organs, however, nothing of course will produce a permanent cure but surgical measures. C. Stuart Hutchinson, during the course of an address to the Central District Medical Association of Iowa, in 1900, speaks of body dry hot air treatments in this condition as follows:

"Dysmenorrhea, due to the neuralgic or rheumatic diathesis, inflammation within the pelvis and parenchymatous nephritis, may be relieved by increasing the elimination through the skin and bowels. Repeated baths cause functional hypertrophy of the sweat-glands and eventually enable them to do more work. In colds the congestion of the nasal mucous membrane can be relieved by one treatment. Syphilitics obtain the same result as from the Hot Springs."

Many of the common organic and structural, as well as functional causes of dysmenorrhea can ordinarily be removed more efficiently by appropriate applications of galvanic, faradic, and static electricity in combination with dry hot air, than by any other measures, surgical or medicinal. It must be administered, however, by one who is experienced and skillful in this particular field, and good judgment must be exercised as to applicability of the agent to the individual case.

Malaria.

The paroxysm of malaria is one situation wherein the general dry hot air application will not produce diaphoresis, or benefit of any kind as far as I have been able to observe. In those occasional obstinate cases wherein the paroxysm persists in returning on the seventh or twenty-first day, however, indicating a low condition of general vitality on the part of the patient, a few of these treatments will render good service in removing the general debility, whereupon the quinine and tonics, which should be administered synchronously therewith, will be able to exercise their customary power over this disease and produce a cure. General static electrifications also are often efficient in performing the same service.

Myositis.

Most commonly encountered during the course of the acute infectious diseases and as the result of traumatism. The local

application will usually prove most satisfactory for its management, relieving the pain and spasmodic tendencies at once. It may be applied every twelve hours for the first two days and once daily thereafter until the muscle has regained its normal condition. (For illustration of its action see pages 141 and 142.)

Osteomyelitis.

Burwash has reported two cases occurring during the course of typhoid fever as cured by local dry hot air treatments. He concludes his report as follows:

"Osteomyelitis is always a very grave disease; the prognosis is so uncertain in any case that the physician is placed in a position of such great responsibility that he feels his helplessness, so that any treatment that will give relief to this serious disease in the first stages is eagerly adopted. The early operative treatment, by cutting down through the bone and into the medullary cavity, to remove the focus of inflammation and disease, is often the only hope for an early extirpation of the disease, but this procedure is not always an easy matter for the surgeon to adopt in private practice.

"The hot air treatment does not interfere with an operation if suppuration develops, while it may be the means of completely arresting the disease in the first stage, and thus obviate the necessity of an operation."

Periosteitis.

When caused by traumatism, this inflammation can frequently be cured by the local application alone, but the writer has seen such gratifying results follow the use of the body treatment that he prefers the latter in the majority of instances. Some cases will not yield until the body treatment has come upon the scene. The aid of the latter should always be invoked when the periosteitis is due to infection, or is of constitutional etiology.

Muscular Adhesions.

Occasionally met with after fracture of the long bones, where the muscles about the seat of the injury have been lacerated by the ends of the fragments. The local treatment is

usually all that is necessary for removing the trouble, but the body application constitutes a powerful reserve when the former proves inefficient. Massage, the static wave current, and galvanism are also efficient in this situation.

Skin Diseases.

The etiology of the majority of the pathological processes which commonly affect the integument would lead to the belief that dry hot air would be immediately useful in their treatment. Experience demonstrates that this is occasionally so, but in the bulk of the cases so far treated, especially in eczemas, marked benefit has not appeared until several weeks and sometimes months after the agent was applied. This may be looked upon as an indication of the fact that in these cases impairment of the trophic nerve centers played a leading part in their etiology, hence the skin disease could not be removed until the general metabolic functions had been gotten upon an efficient basis.

Walsh reports an interesting case of eczema of both hands of long standing. One hand only was subjected to the treatment, but both hands got well: a very pretty illustration of the reflex influence sometimes exerted by this agent. The evidence now at hand indicates that both body and local applications, but especially the body, will prove to be of considerable assistance in the management of skin diseases in the future.

Plumbism.

The following is reported by Corwin:

"Philip B., Italian, aged forty-two. Admitted with diagnosis of plumbism, which had not reached paralytic stage, but muscles crampy. One full bath relieved above conditions, and after four baths patient was discharged well."

The administration of potassium iodide or whatever other drugs are indicated should accompany the dry hot air treatments.

Typhoid Fever.

Up to the present time very few cases of typhoid fever have been subjected to dry hot air therapeusis, hence the time is not

ripe for judgment as to its influence over the primary infection *per se;* but it is, at least, very useful in some of the conditions that obtain during the course of the disease. Myositis, neuritis, and neuralgia, occurring in situations other than about the head, are readily amenable to the local application, and the exhaustion, always threatening and frequently eventuating in dissolution, which sometimes occurs late in the disease, can be controlled, at least in some cases, by the body treatment. The writer has seen life saved under these conditions when the patient's extremities were cold and clammy nearly to the trunk, the *facies Hippocratica* present, pulse running from 150 to 160 beats per minute, a body temperature of 106° F. obtaining, and the sufferer entirely unconscious. The immediate effect of the treatment was to re-establish the circulation in the extremities, bring back the color to the face, and to strengthen the pulse and heart-action to an astonishing degree. The body temperature was increased half a degree by the treatment, but it dropped to 105° F., within two hours, and the patient began to improve after the second treatment, given twelve hours later, eventually recovering from one of the worst attacks of typhoid that I have ever witnessed. She had, altogether, five body treatments, and I am fully persuaded that she would have died had they not been administered.

Another very pretty instance of the stimulating influence of this agent is the manner in which it overcomes the collapse which sometimes follows cold baths. Cold baths exert their beneficial influence through a stimulation of the deep spinal reflexes, but sometimes the nervous system is too much overwhelmed by typhotoxin to be able to react, and depression results. The body dry hot air application exerts its beneficial influence in the same way, but never under any circumstances is its judicious, skillful administration followed by secondary depression. It is worthy of more extensive trial, and the facts already at our command afford grounds for the hope that it will prove to be of considerable use in the treatment of this affection in the future.

The phenomena of over-stimulation are easy of induction in this situation, and the utmost care must be exercised in the

administration of the agent not to exceed a limit appropriate to the individual case. The pulse and body temperature are valueless as guides to the duration and intensity of the treatment, and the general response on the part of the patient must govern. The art which is the result of experience is again invaluable in this connection.

Pains of Flat-Foot.

The permanent removal of such pains cannot be effected by any measure save proper support of the sagging arch, but in hastening adaptation of the supported foot to its new conditions and in relieving the pain temporarily, local dry hot air treatments are very useful. They may be applied every day or two with the technique usual to the procedure. Peckham says, in the *Philadelphia Medical Journal* for August 10, 1901, "There are many cases of flat feet which still continue to be painful, even after all the measures referred to (mechanical support and gymnastics) have been faithfully carried out, and these are the cases which demand something in addition to the routine treatment. A foot that has borne weight all day is hot, tender, and painful, and all motion is limited. A few minutes of massage is extremely soothing to such a foot. The pain is relieved, the foot is rendered much more flexible, and the gymnastic work can then be done with comfort. If heat is applied just before the massage, the result is even better, and heat alone, without massage, is of the greatest value just preceding the gymnastic exercises. In hospital cases I have used the hot air oven in almost every painful case with much benefit. It has also been of great value in cases of contracted Achilles tendons, where gradual stretching was done, the tendon yielding much more and much easier after an hour in the hot oven."

The various static modalities, the continuous current, and mechanical vibratory stimulation are also very useful in this situation, but have not proven to be as satisfactory as dry hot air in the writer's experience. We usually apply these modalities in connection with dry hot air, however.

Obesity.

Body treatments have been lauded as a remedy for obesity, but the writer has never seen them reduce weight markedly or permanently, unless a regulation of diet accompanied their administration. He has not yet been able to convince himself that dry hot air increased the effect obtainable with dietary regulation and exercise when used without this agent, and is unwilling, at the present time, to speak in its favor as a remedy for this condition.

CHAPTER XII.

FIELDS OF FUTURE RESEARCH.

Dry hot air therapeusis is as yet in its infancy, but its physiological action and what has been demonstrated in the way of clinical results up to the present time indicate the lines upon which future experimental work may be conducted. Enough has already been accomplished to establish the agent upon a sound basis as a permanent element in our therapeutical armamentarium. Its powers are exhibited in fields but inefficiently covered by other measures, and the character of its beneficial activity is such as to indicate an extended scope of usefulness in the future. In the fields of future possibilities may be mentioned the following ailments:

Erysipelas.—In Bulgaria it is a common domestic practice to treat erysipelas by holding a red-hot iron or a bare flame close enough to the part affected to scorch the integument, producing a burn of the first degree. Tregubow has adopted this treatment, using the flame of a spirit lamp or a bit of burning cotton which had been previously dipped in alcohol, as the cauterizing instrument, and reports gratifying results. This fact would suggest the use of dry hot air applications in this disease, and the marked benefits which result from their use in other local septic infections afford reasonable grounds for hoping that they may prove useful here. The principles of application and technique would be the same as those described in the section upon local septic infection.

Tetanus.—This is a local infection with micro-organisms in which death results from the action of toxins circulating in the blood which emanate directly from the germ colonies. It is entirely analogous to ordinary septic infection, and in view of the gratifying influence which is exerted by thermotherapy in the latter accident, this agent would seem to be exquisitely ap-

plicable here. As far as I know no cases have as yet been so treated, but in view of the inadequacy of the current methods of management, this affection would seem to offer a promising field for investigation.

Lupus.—Werther and Lichtwitz have reported good results from the use of dry hot air in the treatment of lupus. They employ a temperature of from 150° F. to 250° F. Werther has found the treatment to be very painful, and administers a general anæsthetic, but the experience of Lichtwitz has been diametrically opposed to this. The physiological action of the agent, and the results of its use in other infections, suggest its application to cases of this disease. The remarkably favorable results obtainable with radiotherapy in this connection, however, bid fair to displace, for a time at least, almost all other methods of dealing with the affection, and dry hot air will probably not be investigated in this connection further at present.

Surgical Shock.—One of the means most depended upon for the relief of this condition is the application of heat by means of the hot pack, hot-water bottles placed about the body, etc. By using a body dry hot air apparatus, heat can be applied not only much more easily, but the degree of elevation can be maintained with great uniformity, and the application can be made intense enough to produce a degree of stimulation which, as has already been stated, is not surpassed, and probably not equaled, by any other measure now known. In addition to this, no vicious reaction is to be feared, and it is probable that the body apparatus will be as familiar an adjunct to the surgical operating room of the near future as is the operating table to-day.

Hodgkin's Disease.—The increase of the number of red blood cells dependent upon the application of the body treatment, together with its powerfully stimulant influence upon cell activity and vitality, would seem to rationally indicate its use in this affection. Color is further lent to this supposition by the very satisfactory manner in which dry hot air disposes of localized cultures of the tubercle bacillus in other situations, as in joint tuberculosis. Appropriate drug tonics, general X-

ray applications, etc., should, of course, accompany the thermal agent.

Multiple Neuritis.—Multiple neuritis is dependent upon a variety of causes, many of which exhibit exquisite possibilities for the body treatment, in combination with other appropriate measures, and the affection is usually troublesome enough, both as regards chronicity and suffering, to assure a hearty welcome for any agent that will increase our present ability to overcome the trouble.

Tabes Dorsalis.—Tabes dorsalis and other nervous diseases, characterized by degenerative tendencies, offer a field for apparently fruitful investigation, especially in their early stages. It has already been demonstrated that skillfully applied, appropriate, static electrical modalities will apparently cure some cases of tabes in its early stages. Dry hot air acts in much the same way as electricity, but much more profoundly and permanently in some conditions, and diseases of this nature would seem to constitute a good field for investigation.

Diabetes Mellitus.—Diabetes mellitus is a disease one of the most prominent characteristics of which is sub-oxidation. This, as well as most of the other symptomatic phenomena, constitutes an exquisite indication for the induction of the effects of thermotherapy upon the trophic and metabolic functions.

Mental Aberrations.—Some mental diseases, as paresis. which frequently have their origin in constitutional degenerations or excessive nerve strain, ought to be amenable in some degree to thermotherapy, at least in their early stages. The writer has seen one case of commencing paresis which indicates that a curative result may not be impossible of attainment, and he hopes to see investigations on this line instituted in the insane asylums in the future. Time thus spent would not be wasted even if no benefit in the mental state followed, as the general physical condition of the patients thus treated would be improved.

The Infectious Diseases.—In typhoid fever the employment of the body treatment has already been alluded to, and its effects in this ailment would suggest that it might be useful in other diseases of this class. The writer has applied it to one case

of measles, occurring in a man thirty-eight years old, with most gratifying results. The rash developed with great rapidity and profusion and disappeared entirely, together with the other symptoms of the disease, which had existed with a moderate degree of severity, in four days after the treatment was instituted, when the patient was discharged cured.

This is an encouraging showing when we consider the severity of an ordinary case of measles occurring in adult life. The great profuseness of the rash, and the rapidity with which it developed in this case, would indicate that influence upon the function of elimination played a large part in the production of the beneficial results.

Cerebro-Spinal Meningitis ("Spotted Fever").—A disease of microbic etiology which has been increasingly prevalent during the last year. The writer has had no cases under treatment, but the etiology, pathology, and clinical phenomena strongly suggest that the characteristic influences of the body dry hot air application might profitably be invoked in a remedial capacity. The mortality percentage is so high under the management at present in vogue that careful and thorough investigation of the powers of any measure that promised to exhibit helpful properties, would seem to be justifiable and desirable. That the general dry hot air application holds forth such promise is evident from a study of its physiological action.

Other local and general disease conditions might be mentioned under this chapter heading, but the above are sufficient to indicate the general lines along which future investigations may be expected to develop results, and the belief is held by those most familiar with this therapeutic agent that the prosecution of such investigations will eventuate in the acquisition of helpful knowledge.

INDEX

A

Abdomen, local application to, 57
Action, physiological, of Body Application, 25
  local application, 28, 31
Alcoholism, 247
Analogies, physiological, 32
Anchylosis, bony, in arthritis deformans, 187
  Treatment of, 197
    Fibrous, 241
Angina pectoris, 245
Apparatus, 1
  Different forms of, 1
  For applying dry hot air to open cavities, 18
  Body, essentials in construction of, 2
    Structural modification of, 2
  General local, essentials in construction of, 12
  Knee, 13
  location of, 18
Appendicitis, 201
Applicability, clinical, of dry hot air, 31
Arc light, electric, 23
  In nervous debility and exhaustion, 237
Arthritis deformans, 169
Atheroma, 88, 185, 189

B

Beck on Otitis, 232
Betz, F. S., & Co., of Chicago, Ill., 1
Blood poisoning. See local septic infection
Body dry hot air application
  Effect upon blood composition of, 25
  Effect upon body temperature of, 25
    Capillary circulation of, 26
    Pulse of, 25
    Respiration of, 25
    Urea, excretion of, 26
    Urinary secretion of, 26
In alcoholism, 247
  angina pectoris, 245
  arthritis deformans, 182, 189
  Bright's disease. See Nephritis
  cholelithiasis, 242
  chronic bronchitis, 241
  diabetes mellitus, 257
  dysmenorrhea, 248
  fibrous anchylosis, 241
  gall stones. See Cholelithiasis
  Hodgkin's disease, 256
  la grippe, 246
  lithæmia, 226
  local septic infection, 121, 127
  mental diseases, 257
  multiple neuritis, 257
  muscular adhesions, 250
  myalgia, 230
  myositis, 249
  nephritis, 157, 166
  nervous debility, 237
  neuralgia, 229
  neuritis, 217
  obesity, 254
  paresis See Mental Diseases
  periosteitis, 250
  peritonitis, 201, 206
  pleuritis, 212
  plumbism, 251
  pneumonia, 138, 144
  pulmonary tuberculosis, 238
  rheumatism, 105, 112
  skin diseases, 251
  surgical shock, 256
  synovitis, 213, 216
  syphilis, 247
  tabes dorsalis, 257
  the infectious diseases, 257
  typhoid fever, 252
  weak heart, 25, 88, 252
  varicose ulcers, 231
  valvular heart lesions, 88
Physiological action of, 25
Technique of, 76
Boston Medical and Surgical Journal, 187

Burdick, Dr. G., 240
Burger on gynecic affections, 248
Burns, 87
Burwash, H. J., 201, 250
Busc on radiology, 101

C

Cerebro-Spinal Meningitis, 258
Chair, special for shoulder treatment, 17
Cheney, Dr. A. S., 123
Chest-wall, local application to, 57
Cholelithiasis, 242
Chronic bronchitis, 241
Cleaves, Dr. M. A., 24
Contra-indications to thermaero-therapy, 87
Corwin, R. W., 213, 247, 251
Crothers, Dr. T. D., 24, 248

D

D'Arsonvalization. See Electricity
Diabetes mellitus, 257
Diet
  In alcoholism, 248
    Arthritis deformans, 133
    Bright's disease. See Nephritis
    cholelithiasis, 243
    lithæmia, 226
    local septic infection, 128
    nephritis, 167
    nervous debility, 237
    neuritis, 218
    obesity, 254
    rheumatism, 113
Dropsy, 160, 162, 165
Dutzmann on gynecic affections, 248
Dysmenorrhea, 248

E

Electricity
  In arthritis deformans, 190
    Bright's disease. See Nephritis
    cholelithiasis, 242
    chronic bronchitis, 241
    fibrous anchylosis, 241
    gall stones. See Cholelithiasis
    lithæmia, 227
    local septic infection, 128
    muscular adhesions, 250
    myalgia, 230
    nephritis, 167
    nervous debility, 237
    neuralgia, 230
    neuritis, 218
    peritonitis, 211
    pulmonary tuberculosis, 240
    rheumatism, 115
    sciatica, 222
    sprains, 95
    synovitis, 215
    tabes dorsalis, 257
    uterine pathology, 249
    varicose ulcers, 231
Erysipelas, 255

F

Faradism. See Electricity
Fibrous anchylosis, 241
Fibrous adhesion. See Fibrous anchylosis and Muscular adhesion
  In rheumatism, 98
Fire-proof cloth fittings, 15
Flat-foot, 105
  Pains of, 253
Future possibilities of dry hot air therapeutics, 255

G

Gall stones. See Cholelithiasis
Galvanism. See Electricity
Gangrene, 244
Geyser, Dr. Albert C., 163, 165
Gonorrheal arthritis. See Synovitis
Gout, 227
Grubbe, Dr. Emil, 240

H

Halberstaedter on radiology, 101
Hartley, Dr. Frank, 125
Heart failure in pneumonia, 148
Heart, influence of body application upon, 25, 88, 252
Heart lesions, 88
High frequency current. See Electricity
Hip treatment, 57
Hodgkin's disease, 256
Hopkin's heater, 19
  Technique recommended for use with, 75
Hopkins on Otitis, 232
Hutchinson, C. S., 248
Hydrotherapy compared with dry hot air, 24, 32, 37
  In lithæmia, 227
    Sprains, 95

I

Incandescent light, 23
In alcoholism, 248
Nervous debility and exhaustion, 237
Infection. See local septic infection
Infectious diseases, 257
Intermissions in treatment, 86

K

King on radiology, 101
Kinnear, Beverly C., 137
Knee apparatus, special, 13, 44
Knee, local application to, 44
Kny-Scheerer Co., of New York, 1

L

La grippe, 246
Lead poisoning. See Plumbism
Lewis, Dr. B. S., 143
Lichtwitz, L., 256
Lithæmia, 224
Local dry hot air application
in arthritis deformans, 169, 188
chronic bronchitis, 241
erysipelas, 255
fibrous anchylosis, 241
local septic infection, 119, 126
lupus, 256
muscular adhesions, 250
myositis, 249
nephritis, 150
neuralgia, 229
neuritis, 217
osteomyelitis, 250
periosteitis, 250
peritonitis, 206
pleuritis, 212
pneumonia, 144
pulmonary tuberculosis, 239
rheumatism, 111
skin diseases, 251
synovitis, 215
syphilis, 247
varicose ulcers, 231
Physiological action of, 28, 31
Local septic infection, 117
Location of apparatus, 18
Lumbar region, local application to, 57
Lung, local application to, 57
Lupus, 256

M

Malaria, 97, 249
Marcoe, Dr. Francis, 125
Massage, 32
In arthritis deformans, 193
rheumatism, 112
sprains, 95
McNeil, Dr. Rollin, 141, 143
McLagon, on rheumatism, 97
Measles, 258
Mechanical vibratory stimulation in
Arthritis deformans, 197
Bright's disease, 164, 165
Rheumatism, 116
Sciatica, 223
Sprains, 95
Mental diseases, 257
Morse, on gangrene, 244
Morton wave current. See Electricity
Multiple neuritis, 257
Muscular adhesions, 250
Myalgia, 230
Myositis, 144, 249

N

Nephritis, 150
Nerve stretching in sciatica, 224
Nervous debility, 236
Nervous exhaustion. See Nervous Debility
Neuralgia, 228
Neurasthenia. See Nervous Debility
Neuritis, 217
New England Medical Monthly, 224
New York Medical Journal, 131, 202

O

Oaks on Otitis, 232
Obesity, 254
Œdema. See Dropsy
Operative interference in
appendicitis, 201
local septic infection, 128
neuralgia, 228
osteomyelitis, 250
peritonitis, 201
peritonitis, tuberculous, 202
pleuritis, 212, 213
sciatica, 224
tuberculous synovitis, 214
Osteomyelitis, 250
Otitis, 232
Ozone Inhalations in
chronic bronchitis, 241
pneumonia, 149
pulmonary tuberculosis, 240

P

Periosteitis, 250
Peritonitis, 200
Permanence of results, 40
Physiological action of
  body application, 25
  local application, 28
Pleuritis, 311
Plumbism, 251
Pneumonia, 130
Polano on gynecic affections, 248
Pseudo-angina pectoris, 246
Pulmonary tuberculosis, 238

R

Randall, Dr. W. S., 157, 160
Results, permanence of, 40
Rheumatism, 97
  Chronic, 109, 111, 116
Ringer on burn prevention, 74, 82
Rudis-Jicinsky, Dr. J., 240

S

Salicylic acid and rheumatism, 101
  And arthritis deformans, 194
Salpingitis, 201, 248
Schloss on Otitis, 232
Schreiber, J., 14
Sciatica, 219
Septic infection. See Local Septic Infection
Shoulder, local application to, 56
Shoulder treatment, special chair for, 17
Skiff, Dr. Walter C., 143
Skin diseases, 251
Smith, Andrew H., 131
Spotted Fever. See Cerebro-Spinal Meningitis
Sprague apparatus, 1
Sprains, 92
Stimulation, excessive, 80
  Mechanical vibratory in
    Arthritis deformans, 197
    Bright's disease, 164, 165
    Rheumatism, 116
    Sciatica, 223
    Sprains, 95
Stretch, Dr. James, 109
Surgery. See Operative Interference
Surgical shock, 256
Sverhevsky on Otitis, 232
Synovitis, 213
Syphilis, 247

T

Tabes dorsalis, 257
Technique, 42
  Of body application, 76
    in alcoholism, 247
    angina pectoris, 245
    arthritis deformans, 189
    Bright's disease. See Nephritis
    la grippe, 246
    lithæmia, 227
    local septic infection, 127
    nephritis, 166
    peritonitis, 206
    pleuritis, 212
    pneumonia, 147
    rheumatism, 112
    sprains, 95
    typhoid fever, 252
  Of local application, 43
    in local septic infection, 126
    peritonitis, 206
    pleuritis, 212
    pneumonia, 144
    rheumatism, 111
    sprains, 94
  Knee application, 44
  Pulse and temperature as guides in, 80
Tetanus, 255
Tregubow on erysipelas, 255
Tuberculosis of knee joint, 214
  Pulmonalis, 238
Typhoid fever, 251

U

Uric acid in arthritis deformans, 172

V

Varicose ulcers, 231
Vibration. See Vibratory Stimulation

W

Walsh, J., 29, 251
Wave current. See Electricity
Werther on lupus, 256
Wood on dry hot air in joint diseases, 99

X

X-light in
  arthritis deformans, 178
  intra-abdominal malignant growths, 200
  lupus, 256
  pulmonary tuberculosis, 240
  tuberculosis of joints, 217

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